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THE AMERICAN GAS-LIGHT JOURNAL AND CHEMICAL REPERTORY

Publishing Office, No. 42 Pine Street.

DEVOTED TO THE INTERESTS OF ILLUMINATION, VENTILATION, WATER SUPPLY AND DISTRIBUTION, & GENERAL SCIENCE.

VOLUME XXVIII.—No. 5. Whole No. 449. | NEW YORK, SATURDAY, MARCH 2, 1878 | $3 PER ANNUM IN ADVANCE.

A. M. CALLENDER & CO., Proprietors.
G. WARREN DRESSER, Editor,

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☞ An asterisk (*) denotes an illustrated article

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EIGHTH ANNUAL MEETING OF THE NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.

AT BOSTON, ON WEDNESDAY, FEB. 20TH.

This Association has already established for itself a high reputation, and its meetings are always looked forward to with great pleasure, and usually must result in much good to those who attend, as well as to their employers and customers.

It was a matter of regret that no papers were presented to compete for the "Prize" offered by the Society. The reason of this is difficult to discern. It is not to be supposed that all New England, with her much vaunted School System, could not prepare proper papers to compete for a prize. Neither is it to be supposed that there is no one in New England, even in the gas business, who has not at least *thought* he had something new in the course of a whole year. Why then were there no papers presented? We leave this to some shrewd Yankee to "guess" or "reckon" out to his own satisfaction; but, if there were no papers there was a vast deal of information of a practical character given and received.

There were present as guests and honorary members some of the first men among the Gas Engineers of this country, and the welcome extended them showed that they were appreciated and respected.

The address of the President, Mr. S. G. Stiness, at the opening, was short, clear and explicit in its utterances, and the Association may well rest assured that its true interests will be carefully protected while such men guide and direct its deliberations. A banquet was held in the evening of the first day, and a full meeting was held on the morning of the second day, at which there was a full and free interchange of experience and views. An address by General Charles Roome, of the Manhattan Co. of New York, was listened to with greatest interest and frequent applause. Every one present seemed to feel that the meeting was a most successful one. The returns made to the questions proposed by circular before the meeting, were very generally full and explicit, and a vast amount of most useful information was given which will prove of great value to the members in the future, and will enable them to compare practical workings from time to time with each other. This is an important step in the right direction. The full report of the proceedings will appear in our next issue.

CARBONIC OXIDE.

We call the attention of our readers to an article in another column, by Prof. Henry Morton, PhD., President of the Stevens Institute, upon the qualities of this gas. It is a very extensive and complete compendium of the opinions of the highest authorities on the subject, viewed from Chemical, Toxicological, and Hygienic standpoints. It is a very valuable contribution to gas literature. Our space does not admit of giving the whole of this article in this issue, but it will be completed in the next.

ANNUAL REPORT OF THE TECHNICAL SOCIETY OF GAS INDUSTRY IN FRANCE.

This is an Association of Gas Engineers and Managers, and the report is of the proceedings of their Fourth Annual Meeting, held at Rouen, last June. It is a work of 260 pages, and contains many papers of interest, extracts from which have appeared in this JOURNAL, from time to time since their meeting. When one sees how carefully and fully our French brethren prepare their papers, and the drawings accompanying many of them, as shown in this volume, it encourages the hope that at some future time we may be able to compete, if not surpass them in this respect. Our people think they are too busy to attend to such useless, small details; they "have no time," and so it is too often the case that what would be a very valuable contribution to the information and literature of the profession is much depreciated by want of proper care in arranging the facts and presenting the details. We are a busy people; but no more so than others. One reason; why, we "never have time for preparing a paper," is that there is a want of system in first collecting; and secondly, classifying and arranging facts *from day to day*. And the result is, that at some time when information upon some particular point is wanted there, *is* no time to go all over a mass of unarranged and unclassified figures to pick out the facts we need. The habit of care and precision, and completing *daily* the statistics of our business, is what is wanted; and, this being done, very little labor will enable many of our engineers to present papers upon many topics connected with the business in hand that will campare favorably with any, and render our Associations second to none at home or abroad, in the real practical good which they will accomplish in promoting the interests of their profession.

GAS CONSUMERS HANDY BOOK.

This is a little volume from the press of E. & F. N. Spon, by Wm. Richards, C. E., intended for the use of Gas Consumers, that they may more intelligently, avail themselves of the many advantages which the use of gas brings to every household. It treats in a plain practical way of the quality and various applications of gas; of the different burners in use, and the proper adaptation of them to the service required; of gas stoves, and cooking apparatus, and explains that much abused instrument, the meter, and how to read it, together with directions as to the proper position of gas lights, the regulation of pressure, and closes with a few sensible words upon ventilation, and its relations to the proper combustion of illuminating gas.

A PRACTICAL TREATISE ON HEAT.

BY THOMAS BOX.—SECOND EDITION.

This new edition based upon the former one has been enlarged and made much more thorough, especially in treating upon evaporation, heating liquids and air, ventilation, etc. It has one element essential to every book which may be often required for reference, viz.: A full index. The book contains a great deal of very useful information, carefully presented in a simple form, and seems to us to be one of those volumes that should be in every Gas Managers' Library. As it deals so largely in the facts concerning, combustion, chimneys, vapours, evaporation, distillation, heating liquids and air, the transmission of heat and the laws of cooling, ventilation, etc., etc. The work contains many valuable tables and several plates very neatly executed. The book is neatly bound in cloth, printed in good clear type, and in every way is creditable in its appearance to the publishers, Messrs. E. & F. N. Spon, of London. The price is $5, and copies may be ordered from this office.

REPORT OF THE ASTOR LIBRARY FOR 1877.

The Trustees of the Astor Library in obedience to their Act of Incorporation, have made their 29th Annual Report, a copy of which has been sent us. From the Treasurer's Report it appears that for books, binding and catalogues, the sum of $32,113 has been expended, of which $27,815 was for the purchase of books alone.

During the past year 11,533 volumes have been added to the library.

The total number of readers for the year was 58,621. An increase of 23% over 1876.

Total number of volumes in the library on January 1st, 1878, was 177,387. As there are several libraries in the city especially devoted to special departments, such as Theology, Jurisprudence, Medicine, Natural History and Geography; it has been the policy to direct the principle expenditures in the purchases of books towards the completion of other important subjects. Many serials and transactions of societies have been completed to date, while of new works procured only those of permanent and intrinsic value have been bought. The patents, English, American and French, together with works relating to arts and manufactures have been largely increased and much consulted.

[Communicated Article.]

Carbonic Oxide.
Is It a Harmless Anæsthetic or a Virulent Poison?

[By HENRY MORTON, Ph.D., President of the Stevens Inst. of Technology.]

In reply to questions put to me on the subject some time since, I stated that carbonic oxide, according to the opinion of the standard writers, was undoubtedly a virulent poison; and, therefore, that this gas was a very objectionable constituent in any mixture which was to be distributed for illuminating or other purposes.

Since the publication of this statement of mine I have noticed that there have been published, in various journals, or printed and circulated, various statements which, more or less indirectly, seem to call in question the soundness of my views on this subject.

As, after all, this is simply a question of fact, on which any one, with the data before him, is competent to form a judgment, I have thought it worth while to compile all the statements by standard authors which were in my reach, and so let them speak for themselves. Whether or not such a gas, as will be there found described, should be considered a "virulent poison," and would be "objectionable," may then be left to the reader for decision, with his common sense for a sufficient guide.

Following a general chronological order in the succession of quotations, I find as follows:

Murray's Chemistry, Edinburgh, 1809, Vol. II., p. 546. Under "carbonic oxide," he says: "It is fatal to life when inspired."

Cutbush's Chemistry, Philadelphia, 1813, Vol. I., p. 126. Under "carbonic oxide." "*Experiment* 4. If a *mouse*, or other small animal be immersed in a jar of this gas, it will destroy it in a short time. *Remark.* This gas is, therefore, deleterious to animal life. When respired for a few minutes it produced giddiness and fainting."

Gorham's Chemistry, 1819, Vol. I., p. 380. Under the heading "carbonic oxide." "It is incapable of supporting combustion, and is fatal to animal life. Sir H. Davy once took three inspirations of it mixed with about one-fourth of common air; the effect was a temporary loss of sensation which was succeeded by giddiness, sickness and acute pains in different parts of the body, and extreme debility. Some days elapsed before he entirely recovered."

Brande's Chemistry, London 1821, Vol. I., p. 120. Under "carbonic oxide," he says: "It is fatal to animals." Of carbonic acid he says only (p. 429) "it is irrespirable."

Ure's Dictionary of Chemistry, 1821. Article, "'Carbonic oxide' when inspired is fatal to animal life." The account of Sir H. Davy follows, and then: "Since then Mr. Wilter, of Dublin, was struck down in an apoplectic condition by breathing this gas, but he was speedily restored by the inhalation of oxygen."

Parkes' Chemical Catechism, N. Y., 1818, p. 406. Under "carbonic oxide." "It is a gas that will not itself support combustion, neither is it fit for animal respiration. According to some French chemists, birds drop down dead immediately on being put in this gas. These chemists attempted to breathe it themselves; but it produced giddiness and faintness.—*Annales de Chimie*, T. xxxix, p. 56."

Henry's Chemistry, London, 1823, Vol. I., p. 347. Under "carbonic oxide." "It is extremely noxious to animals; and fatal to them if confined in it.

Webster's Chemistry, Boston, 1828, p. 203. Under "carbonic oxide." "It is extremely noxious to animals; and fatal to them if confined in it. When respired for a few minutes, it produces giddiness and fainting."

Thompson's Chemistry, London, 1831, Vol. I., p. 168. Under "carbonic oxide." "No animal can breathe it; when the attempt is made one or two inhalations occasion asphyxia. All gases containing carbon have been found positively injurious when drawn into the lungs."

Thenard's Chemistry, Paris, 1834, T. I., p. 274. Under "carbonic oxide." "It kills immediately the animals who breathe it."

Berzelius' Chemistry, Paris, 1838, T. I., p. 222. Under "carbonic oxide." "Animals die immediately in carbonic oxide gas, and persons who have tried to breathe it have fallen down unconscious."

Daniel's Chemistry, London, 1843, p. 356. Under "carbonic oxide." "It is speedily fatal to animals.'

Turner's Chemistry, London, 1847, p. 232. Under "carbonic oxide gas." "It cannot support respiration. It acts injuriously on the system, for, if diluted with air and taken into the lungs, it very soon occasions headache and other unpleasant feelings, and when breathed pure it almost immediately causes profound coma."

Graham's Chemistry, London, 1850, Vol. I., p. 370. Under "carbonic oxide." "It is very fatal to animals, and when inspired in a pure state almost immediately produces profound coma." Of carbonic acid he says simply (p. 364), it "does not support animal life."

Encyclopedia of Chemistry, by Booth and Morfit, Philadelphia, 1850, p. 418. Under "carbonic oxide." "No animal can breathe it, and it is more poisonous than carbonic acid."

Gmelin's Chemistry, London, 1849, Vol. II., p. 89. Under "carbonic oxide." "Small animals immersed in it die instantly. When inspired it produces giddiness and fainting fits. (Clement and Desormes), even mixed with a fourth its bulk of air (H. Davy); it is much more poisonous than carbonic acid."

Regnault's Chemistry, Philadelphia, 1852, Vol. I., p. 321. "'Oxide of carbon' is not merely passive in not supporting respiration, but is active as a poison; for an animal perishes if left for some time in an atmosphere containing a few per cent. of this gas.

"To its presence must be attributed the uneasiness and headache experienced by remaining in a badly-ventilated apartment, near a furnace containing burning charcoal, the products of which do not immediately pass up the chimney. If a large proportion of carbonic oxide gas be present in a closely shut room death ensues from asphyxia."

Chenot. Article in the Comptes Rendus of the French Academy, 1854, p. 735, "On pure carbonic oxide considered as a poison."

In this article its author describes the action of carbonic oxide in such terms as the following:

"The pure carbonic oxide is not simply a reducing agent of the greatest energy, but a frightful poison (*un poison foudroyant*) in very small dose. Finally it appears that poisoning by carbonic oxide is the most terrible in itself and brings after it profound disorganization." This author speaks from his own experience, having suffered several times very seriously from accidental inhalations of small quantities of this gas. In a continuation of this same subject, at a subsequent date, (see p. 830 of the same volume) M.

Chenot relates a number of facts which had been brought to his notice illustrating the dangerous properties of carbonic oxide even when mingled with air.

Payen's Industrial Chemistry, Paris, 1859, T. I., p. 93, Foot note (*). "The production of 'carbonic oxide,' in consequence of an insufficient quantity of air (or oxygen) during combustion, occasions great danger to the health of the workmen, if this poisonous gas is mingled with the air which they breathe."

Stockhardt's Chemistry, Philadelphia, 1861, p. 100. "CO, 'carbonic oxide' is extremely poisonous when inhaled, and constitutes what the miners call coal gas. * * * Notwithstanding repeated warnings accidents not seldom occur from the fumes of burning charcoal."

Lorme's Chemistry. Paris, 1861, T. I., p. 318. *Note.* "The gas 'carbonic oxide' is produced in large quantity when carbon burns in an insufficient quantity of air. It is this which sometimes happens in our rooms. It is especially to the presence of this gas that we should attribute asphyxia from coal, and not to carbonic acid. There is great danger in breathing air which contains some hundredths of carbonic oxide; this gas acts as a pure poison, thus to escape the deleterious influences which it exercises on the constitution it is necessary to ventilate thoroughly the rooms in which carbon is burned."

Chemical News. Article by H. Letheby, Prof. of Chem. and Toxicology in the Medical College of the London Hospital Apr. 19, 1862, p. 212. "'Carbonic oxide' was discovered by Priestley long before the close of the last century; and in 1802, Clement and Desormes, at the instance of Guyton Morveau, undertook a careful examination of its properties. They not only proved its chemical nature, but they also ascertained that it was a poisonous gas. Birds put into it dropped dead before they could be taken out; and when the experimenters themselves attempted to breathe it, they were attacked with giddiness and faintness.* * * * * "Later still, in 1814, the two assistants of Mr. Higgins, of Dublin, made experiments with it upon themselves, and in one case, that of Mr. Wilter, with almost a fatal result. Having exhausted the lungs of air, he inhaled the pure gas three or four times, and was suddenly deprived of sense and volition; he fell upon the floor, and continued in a state of perfect insensibility, resembling apoplexy, and with a pulse nearly extinct. Various restorative means were employed, but without success, until they resorted to the use of oxygen, which was forced into his lungs, and then his life was restored; but he was affected with violent convulsive agitation of the body for the rest of the day. He suffered also from violent headache, stupor, and a quick, irregular pulse. Even after mental recovery he suffered from giddiness, blindness, nausea, alternate heats and chills, and irresistible sleep. The other gentleman, after inhaling the gas two or three times, was seized with giddiness, tremor, and incipient insensibility. These effects were followed by languor, weakness, and headache of some hours' duration.

"Since those experiments were made, others of a more extended character were instituted by Tourdes and by Leblanc. Tourdes found that rabbits were killed in seven minutes when they were put into a mixture of one part of the gas with seven of atmospheric air. A fifteenth part of the gas in common air killed them in twenty-three minutes; and a thirtieth part in thirty-seven minutes. Leblanc's experiments were made in conjunction with Dumas, and he ascertained that one per cent. of the gas in atmospheric air would kill a small dog in a minute and a-half, and that birds were killed immediately in a mixture containing five per cent. of it.

"Very recently I have myself ascertained that air containing only 0·5 per cent. of the gas will kill small birds in about three minutes; and that a mixture containing one per cent. of the gas will kill in about half this time. An atmosphere having two per cent. of the gas will render a guinea-pig insensible in two minutes; and in all these cases the effects are the same. The animals show no sign of pain; they fall insensible, and either die at once with a slight flutter—hardly amounting to convulsion—or they gradually sleep away as if in profound coma. * * *

"Accident has also demonstrated how injurious the gas is even to the human subject. For many years past attempts have been made to promote the use of water-gas as an agent of illumination. The gas sometimes contains as much as thirty-four per cent. of carbonic oxide. It is obtained by passing steam over red-hot charcoal; and as the steam is decomposed by the ignited carbon, the hydrogen is set free, and carbonic oxide, with carbonic acid, is produced. Patents for this process of manufacturing gas date as far back as the year 1810, and they have at various times been put into operation in this country and on the Continent. Sellingue, in 1840, obtained permission to use the gas in the towns of Dijon, Strasburg, Antwerp, and two of the faubourgs of Paris and Lyons. At Strasburg an accident occurred which put a stop to its use. The gas escaped from the pipes into a baker's shop, and was fatal to several persons; and not long after an æronaut, named Delcourt, incautiously used the gas for inflating his balloon. He was made insensible in the car; and those who approached the balloon to give him assistance fainted and fell likewise. The use of the gas, therefore, has been interdicted on the Continent."

Reissig. Munich. Handbook of wood and peat illuminating gas manufacture, Munich, 1863, p. 59. Speaking of wood gas especially, he says that its inhalation may produce death.

"This latter gas, in particular, is dangerous on account of its large contents of carbonic oxide. Hydrogen, and light carburetted hydrogen, can be much more readily respired without injurious consequences; but not so carbonic oxide.

"The poisonous effects of this gas are known. Every year the lives of many are sacrificed to it, persons who are suffocated by the so-called charcoal fumes, *i. e.*, carbonic oxide.

"Great caution, therefore, should be used, and the main cock should be turned every evening by some reliable person, so that only small quantities of the gas can escape."

Bloxam's Chemistry, London, 1868, p. 78. "'Carbonic oxide' is a gas of so poisonous a character that, according to Leblanc, one volume of it diffused through 100 volumes of air totally unfits it to sustain life; and it appears that the lamentable accidents which too frequently occur from burning charcoal or coke, in braziers and chafing-dishes, in close rooms, result from the poisonous effects of the small qunatity of carbonic oxide which is produced, and escapes combustion, since the amount of carbonic acid thus diffused through the air is not sufficient in many cases to account for the fatal results."

Fowne's Chemistry, Philadelphia, 1869, p. 168. Under "carbonic oxide." "It is colorless, has very little odor, and is extremely poisonous—much more so than carbon dioxide."

The peculiar red color of the blood observed in the bodies of those poisoned by carbonic oxide long after death, was noticed at a very early period (at least prior to 1850), and in 1865 an elaborate investigation was published, by Hoppe-Seyler, in the *Zeitschrift fur Analyt. Chemie*, V. III., p. 439. A good abstract of this will be found in the Philosophical Magazine, IV. Series, Vol. XXX., p. 456.

It is entitled "On the detection of poisoning by carbonic oxide." and shows how the changes in the blood, produced by this poison, can be recognized by the spectroscope even after many days.

Miller's Chemistry, London, 1867, Vol. II., p. 72. Under "carbonic oxide." "When respired, even though largely diluted with air, it acts as a direct poison, producing a peculiar sensation of oppression and tightness of the head."

Duflos' Handbuch der angewandten Chemie, Leipzig, 1873, p. 36. "A contents of one-fourth per cent. of carbonic oxide in air gives it the above-mentioned injurious action (dizziness, vomiting, fainting, and finally death), and even with a much smaller amount in a prolonged exposure to such an atmosphere, health may be very seriously endangered."

Hasselt. Handbuch der Giftlehre fur Chemiker, etc., 1862. In Vol. II., on p. 352, says—

"'Carbonic oxide' has been found to be a most active narcotic poison for man. The poisonous effects of coal gas are probably due to this."

Hermann. Lehrbuch der experimentallen Toxikologie, 1874, Berlin. "Warm blooded animals soon die in an atmosphere containing carbonic oxide; even very small quantities down to one per cent. are sufficient."

Bernard. Lecons sur les effets des substances toxiques. Paris, 1856. This author says—

"Carbonic oxide is one of the most poisonous gases known."

Eliot & Storer's Chemistry, New York, 1871, p. 338. Under "carbonic oxide." "It extinguishes combustion just as hydrogen does, and destroys animal life. Unlike hydrogen and nitrogen, however, it is a true poison. It destroys life, not negatively by mere suffocation or exclusion of oxygen, but by direct noxious action. Even when largely diluted with air it is still poisonous, producing giddiness, insensibility, and, finally, death. It is the presence of this gas which occasions the peculiar sense of oppression and headache which is experienced in rooms in which the products of combustion have escaped from fires of charcoal or anthracite. Carbonic oxide is very much more poisonous than carbonic acid. Much of the ill repute which attaches to carbonic acid really belongs to carbonic oxide; for since both these gases are produced by burning charcoal, many persons are liable to confound them; but carbonic acid is comparatively speaking almost innocuous. Carbonic acid, it is true, is somewhat poisonous; it does not merely suffocate like water, or nitrogen, or hydrogen; but it is very much less poisonous than carbonic oxide. It has been found by experiment that an atmosphere containing only 1-100dth of carbonic oxide is as fatal to a bird as one containing 1-25th part of carbonic acid."

Barker's Chemistry, New Haven, 1870, p. 237. Under "carbonic oxide." "It is totally irrespirable, being an active narcotic poison, one per cent. in the air proving fatal."

Wagner's Jahresbricht, 1874, p. 988. Under "carbonic oxide. "The presence of this poisonous gas was at first, and that justly, urged against the application of water-gas, it has, however, been found that at higher temperatures carbonic

* The original article by Desormes and Clement will be found in the Annales, Vol. 39, p. 26. The passage here quoted is on page 56.—H. M.

oxide may be oxidized by means of steam into carbonic acid, so that by employing an excess of steam a gas comparatively free from carbonic oxide can be obtained."

Cooke's Chemical Philosophy, Cambridge, 1875, p. 462. Under "carbonic oxide." "The gas is devoid of odor or taste, is very poisonous, etc."

Schorlemmer, Chemistry of Carbon Compounds, London, 1874, p. 63. Under "carbonic oxide." It is but sparingly soluble in water, and acts as a strong poison, producing death when inhaled even in small quantities."

In the Annales de Chimie et de Physique, 1842. Third Series, Vol. V. pp. 223–268, we find a long article, by M. F. Leblanc, under the title —"Recherches sur la composition de l'air confine." In this extensive treatise, covering some 45 pages, the author, after describing experiments in which it was proved that the actual products of the combustion of a candle, or of charcoal, were far more poisonous than pure carbonic acid mingled with air continues as follows :

"Although the opinion generally received did not appear to attribute to carbonic oxide, especially when present in small quantity, a deleterious action on the animal economy, I wished to ascertain by precise experiments the part of the influence it could exercise in the effects of the combustion of charcoal. I studied at the same time the action of the gases proto and bicarburetted hydrogen.

"Regarding these latter products, experiment shows that they cannot have an active part in the asphyxiating effects of charcoal. The gas protocarburetted hydrogen obtained from acetates, and oleflant gas, can be mixed with air, in the proportion of one to two hundredths, without causing any apparent accidents, even at the end of a considerable time. Such is not the case with carbonic oxide. A dose of four to five parts in a hundred of air caused the instant death of a sparrow. A hundredth part of this gas mixed with air killed a bird at the the end of two minutes. If the animal is immediately removed from this deleterious influence at the moment of apparent death, it can little by little regain life; but it is often only after some hours that the phenomena of paralyzation disappear.

"We must, therefore, look upon carbonic oxide as a gas eminently deleterious, contrary to the conclusiens of Nysten, who had placed this compound among the simply irrespirable gases. This latter opinion besides has not been adopted by M. Devergie, in his new *Traite de Medecine legale*, and in his excellent article on the gases. (Dictionnaire de Medecine et de Chirugie pratiques). Observing that the injection of carbonic oxide into the veins, according to Nysten's experiments, caused the animals to utter cries of pain, and relying moreover on the effects experienced by Samuel Witte (1) after a few inspirations of this gas, M. Devergie does not hesitate to place carbonic oxide among the deleterious gases (2).

"According to the facts here given we are led to admit that carbonic oxide habitually plays the principal part in the deleterious effects produced by the combustion of charcoal."

And further on, p. 246 :

"We have pointed out that the toxical property of an asphyxiating atmosphere under these influences should be attributed more particularly to the presence of carbonic oxide ascertained by analysis, since, even when diffused in air to the extent of one part in 100, it forms an atmosphere almost immediately fatal to warm blooded animals; the observed proportions of carbonic acid present, and of oxygen wanting, would not produce nearly such violent effects. It is, therefore, necessary to point out without delay the dangers which may result from the accidental presence of carbonic oxide in air, dangers to which, as far as I know, our attention has not yet been sufficiently called, especially to the influence of such small quantities."

So far we have given quotations expressing the general literature of this subject; now we will turn to the special departments which concern themselves with such substances as we consider "carbonic oxide" to be—namely, Toxicology, the science of the detection and counteraction of poisons; Hygiene, the science of preserving life and health from destructive agencies.

In Werker's "Lehrbuch der praktischen Toxicologie," Erlangen, 1869, p. 81, we find as follows :

"Although pure carbonic oxide possesses but little interest in practical toxicology, it has become a matter of great importance on account of the continually increasing number of accidents resulting from charcoal fumes and illuminating gas, in which carbonic oxide occurs mixed with other gases, and of which it forms the specially poisonous constituent. The symptoms, altogether similar, and the condition of the body after death prove conclusively the truth of this latter opinion, although it will not be denied that other admixtures, carbonic acid for instance, may have some effect. Poisoning with pure carbonic oxide can only occur from the careless performance of chemical or physical experiments.

"The gases resulting from the reduction of many metals, (zinc furnaces, etc.), are always more or less mixed with carbonic acid, and resemble charcoal fumes. Three to five per cent. of carbonic oxide mixed with air kills dogs and cats in three to five minutes, birds are specially sensitive, invertebrate animals very little. * *

"The gases resulting from glowing charcoal, coal or peat contain on an average 2.54 per cent. of carbonic oxide and 24 per cent. of carbonic acid.

Poisoning from charcoal fumes is especially frequent in France. Statistics show that of the 17,852 suicides, occurring in the years 1848–52, 1,401 were from charcoal fumes, and 411 from other poisons.

"That the poisonous character of charcoal fumes is due to carbonic oxide, is proved by the fact that their poisonous nature is retained after removing the carbonic acid by lime water.

"Illuminating gas which, as is well known, is produced by the dry distillation of coal or wood, and lately, also, of petroleum, varies very much in composition, according to the material employed, the heat applied, and the more or less perfect purification. * * *

"Marsh gas, like hydrogen, is only irrespirable, but not poisonous. In the case of olefiant gas this is not absolutely established, for, according to some observers, it is said to produce a slight giddiness. Its effect is certainly a very slight one, and on account of the small quantity found in the gas it has probably no influence. We must then consider carbonic oxide as the poisonous principle."

Numerous other statements, similar in effect, are found in the same work; but to quote them all would occupy too much space, and would not add to the force of what we have already transcribed.

Turning next to "Eulenberg's Handbuch der Gewerbe-Hygiene," Berlin, 1876, p. 344, we find as follows :

"The effects of carbonic oxide agree with those of carbonic acid only in so far that, with small quantities, there may also be decided symptoms of irritation, which, however, far more rapidly than in the case of carbonic acid, pass into general prostration." Then, after enumerating at length the preliminary symptoms, he continues :

"If help is not rapidly rendered there follows prostration, with somnolency, enlargement of pupils, cold perspiration, coldness, loss of feeling in the skin, relaxation of the muscles, difficult breathing, slow pulse, and then death rapidly follows."

On page 347 the author gives a series of experiments on doves and rabbits, with mixtures containing carbonic oxide and carbonic acid mingled with air, in various proportions, from ½ p. c. to 3½ p. c., and then says in conclusion :

"We see, from these experiments, that a slight increase of the amount of carbonic oxide produces, altogether independently of the larger or smaller amount of carbonic acid, the characteristic symptoms of charcoal fume poisoning. Might not the *prolonged* action of *small quantities of this gaseous mixture* be of importance in the production of pulmonary affections?"

On page 352, the same author says : "For sanitary reasons, on account of the very poisonous properties of carbonic oxide, all processes in which this gas is produced should be very strictly watched."

"On page 603, he says : "In the case of illuminating gas, the most dangerous cases are those in which poisonings occur in houses where no gas is consumed, and where it has entered only in consequence of leaks from mains in the streets."

"Remarkable cases of this kind, which were mistaken even by physicians for typhoid cases, have been described by Pettenkofer. "Die Bezrehung der Luft zur Wohnung, etc., p. 87." "Relations of air to our dwellings."

M. G. Tourdes, whom we shall have occasion to quote presently in another connection, has published a pamphlet entitled "Relation Medicale des Asphyxies occasionees a Strasburg par le Gaz de l'eclairage."

The incident here related and discussed was the poisoning (resulting fatally in several cases) of an entire family, caused by a leak from a pipe conveying water-gas.*

Devergie, in his Medecine Legale, Paris, 1852, Vol. III., p. 82, after quoting the experiments of Nysten on men and animals, says :

'These experiments plainly show the deleterious action of carbonic oxide, and the following, which was made and reported by Samuel Witte, (Bibl. brit. sc. et arts, LXI.) leaves no doubt in this regard." He then describes the experiment, at the end of which he says: "The usual methods resorted to in cases of asphyxia remained without avail. He was then treated with oxygen gas, which brought him back to life."

On turning next to the immense work which bears the modest title—"A handy book of Forensic Medecine and Toxicology," by Woodman and Tiely, London, 1877, we find, on page 557, as follows ;

"Carbonic oxide, when respired passes freely into the lungs, as much as 4 per cent. being found in the blood of animals exposed for from 10 to 25 seconds to an atmosphere containing 10 per cent. of this gas. When absorbed by the blood it combines with the hæmoglobin. * * *

* * "The poisonous action of carbonic oxide was noticed by Guyton Morveau, in 1802, and by Sir H. Davy, in 1810." * * *

* * "Mr. Higgins, of Dublin, Tourdes, Leblanc, and Letheby, have also experimented with it. Tourdes proved that one part of gas in

* See quotation from Letheby above.

seven of air, killed rabbits in seven minutes—one in fifteen, in twenty-three minutes—and one in 30 in 37 minutes."

"Leblanc and Dumas' experiments show that air containing one per cent. of the gas will kill a dog in one and a-half minutes, and that birds die instantly in an atmosphere containing five per cent. Dr. Letheby found in his experiments that air containing ½ per cent. of the gas kills small birds in about 3 minutes; whilst if it contains one per cent., it proves fatal in about half the time. An atmosphere containing two per cent. rendered a guinea-pig insensible in two minutes. There were no signs of pain—but the animals fell down insensible, and died at once, either with a slight flutter, hardly amounting to convulsion, or gradually slept to death, as if affected with a profound coma. Carbonic oxide is in short a pure narcotic poison. * * * *

"The large quantity of carbonic oxide in water gas (often 34 per cent.) would render its employment dangerous as an agent of illumination." * * *

On page 557 of the same work we find as follows;

"In London gas the amount of carbonic oxide varies from five to seven per cent.; light carburetted hydrogen, 40 to 45 per cent.; and olefiant gas, three to four per cent. There is little doubt that carbonic oxide is the most actively poisonous of the gases present.

"Indeed some have stated that it is the only poisonous body, (M. Tourdes). But it is more than probable, as Dr. Taylor suggests, that the various hydrocarbons present have also a noxious influence. It is curious, however, that in a very dilute state, *pure* carburetted hydrogen does not appear dangerous to health, inasmuch as the miners breathe it continually without any apparent ill effects resulting."

[To be continued.]

On the Hayford Process and Apparatus for Preserving Timber.

By Edward R. Andrews, of Boston.

[Continued from page 70.]

It is *dryness*, then, and the waterproof and air-tight qualities imparted to wood by its impregnation with creosote oil, which give it its superiority over every other substance used for preserving wood. The presence of heat and moisture is necessary to induce decay; heat without moisture is harmless. Wood absolutely dried by some artificial process of desiccation will not decay, if it can be kept perfectly dry afterwards; hence, wood, which has been dried, has been preserved. Wood once dried, and then so protected that it can under no circumstance absorb moisture, has been rendered practically imperishable, except from wear.

When wood has been treated by the Bethell system, if the work has been faithfully done, it will not absorb moisture, and is, therefore, well preserved against decay.

Why, then, is not the Bethell system sufficient, you will ask? The answer is simply because only dry wood can be effectually treated by the Bethell process, and in this country we must treat green lumber. No system of wood-preserving can be made practicable here, which does not embrace some effectual method of drying green wood rapidly.

This defect of the Bethell system has always been recognized in Europe, where ties and timber intended for creosoting, are stacked up from nine to twelve months to season.

At a discussion on the preservation of telegraph poles, in 1876, by Mr. Braine, Superintendent for J. Bethell & Co., London, made these remarks; "Dryness is the principal quality required in timber that is to be creosoted. Timber is sometimes delivered *dripping-wet*, and the creosoting firm expected to creosote it without delay. * * It is perhaps better that timber should not be creosoted at all than creosoted moist."

With us timber is used directly from the cars or vessel. We cannot wait for timber to season. It is not cut from the log until needed for construction. We must be prepared to take timber as it comes from the saw-mill, and in a few hours season and preserve it.

The Bethell system will not do this; oil and water will not mix together. So long as the pores of wood are reeking with sap and river water, it is impossible to inject into them any preservative substance. Hence, it is evident that the Bethell process needs some radical modifications before it can be adapted to the wants of this country. These modifications are precisely what have been made in the Hayford patents.

The important claims of the Hayford process are: *Dryness* before impregnation with any preservative substance, a complete coagulation of the albumen of the sap by heat, the evaporation of the watery portions of the sap, and the withdrawal of all moisture, sugar, acids, etc., in vacuo, leaving a pure wood fibre, fully preserved against decay, except from contact with air and moisture. There is no patent for the use of creosote oil. The Hayford patents cover improved processes for preparing wood to receive any preservative substance required, and apparatus for injecting such substance into the pores of wood thoroughly and rapidly.

Apparatus.

I will now describe, as clearly as I can, the apparatus used in the Hayford process, and then try to show wherein it brings about the results I claim. The apparatus is simple and strong. At my works at South Boston, I have endeavored to have perfect security from accident, and, at the same time, the best fitted and strongest plant ever erected for wood preserving.

It consists mainly of an 85-horse boiler, a pump, a tank to contain oil, and a cylinder in which the wood is treated. The *cylinder* is the most important part of the works, and upon its perfect construction depends the commercial success of the enterprise. It is 100 feet long, 6 feet in diameter, made of ½ inch boiler iron steam rivetted. On either end, a cast gun-iron ring is riveted, which serves as a jam to a wrought-iron door made of plates ¾ inch thick, bent to a semi-globular form and riveted to a gun-iron ring of same dimensions as the ring in the cylinder. This door is hung to the cylinder by a hinge, which, however, acts as a guide only, the weight being supported by a strong wheel, which rolls on a track with a solid foundation. A rubber-gasket makes the joint between the rings perfectly tight. The cast-iron rings are pierced with bolt holes, through which thirty-six bolts pass. On one end of each bolt is a case hardened nut, and at the other is pierced an eye, into which slips one of a series of steel keys, arranged upon a ring, which revolves about the cylinder by a screw motion, by which means all the bolts are fastened or unfastened at once. It is necessary to give a few turns to the nuts with a wrench, to make the joints perfectly tight, before commencing a treatment, or to loosen the strain when the treatment is over, and the doors are to be opened; but by this simple mechanical contrivance, the great labor of opening and closing the doors is made comparatively easy.

The cylinder rests on rollers, to allow for expansion and contraction, supported on brick piers. This cylinder is a perfect piece of boiler work, and has been tested by hydrostatic pressure of 200 pounds to the square inch. There is no leakage during the process, when the pressure reaches from 100 to 150 pounds. Great annoyance has been frequently experienced with cylinders made for wood preserving on account of leakage, and danger also from want of strength in the heads, generally of cast iron, which broke under the required strain.

A railway track, 3 feet 4 inches wide, runs through the cylinder, and extends 100 feet beyond at either end, so that iron cars can be loaded with lumber at one end and be discharged at the other. Between the tracks, at the bottom of the cylinder, lies a coil of steam-pipe 1400 feet long, which connects with the boiler at one end, and at the other has outlets both with the outer air and with the inside of the cylinder, that the steam, after passing through the coil, can be allowed to escape into the cylinder when desired.

A series of perforated pipes is arranged around the inside of the cylinder, for the purpose of introducing the oil. These are connected with the oil tank. They are so arranged that, when the oil is let on through them, every stick of wood in the cylinder is at once bathed with oil.

The oil tank is simply a receptacle to contain the oil, and of capacity sufficient for the purpose. It is strong enough to stand a pressure of 100 pounds to the square inch. A coil of steam pipe, connected with the boiler, is laid through it for the purpose of heating the oils to the required fluidity.

A simple, but powerful pump is so provided with valves and pipes that by opening one set of valves and pipes it is a force pump, and by closing these and opening another set it becomes a vacuum pump. A water-jacket around the air-chamber keeps it cool while in operation. The necessary piping to connect the parts together completes the apparatus.

Hayford Process.

The first part of the process is for the purpose of drying the timber.

The wood to be treated has been placed upon iron cars, and run into the cylinder, which is hermetically closed. Steam is then admitted through the coil in the cylinder, and after passing through the coil, it escapes into the cylinder itself. The temperature in the cylinder very soon reaches 180 deg. Fahr. It rises very slowly from this point, the evaporation of the sap and moisture in the wood tending to cool the temperature. It is best that the heat should increase gradually and that it should be kept moist. If allowed to be too dry, the outer fibres of the wood naturally harden, and thus prevent the escape of the moisture within. To avoid this, and also to save all the heat, the exhaust from the pump is also admitted into the cylinder. The pump is set at work to force atmospheric air into the cylinder, until the pressure gauge shows a pressure of 30 to 40 lbs. to the square inch. The object of this is to keep the wood from checking; green wood, in large dimensions, when exposed to high temperature, has a tendency to check. A vacuum forms about the wood, arising from the condensation of steam, and the expansion of the moisture within the wood tends to throw apart its fibres. This tendency is counteracted by the atmospheric pressure above stated. And thus a higher degree of heat can be used in drying the wood without injury to its fibres. 250 deg. to 270 deg. are sufficient to evaporate the sap.

[To be Continued.]

THE AMERICAN GAS-LIGHT JOURNAL AND CHEMICAL REPERTORY

A. M. CALLENDER & CO.,
PROPRIETORS.

Editor—G. WARREN DRESSER.

PUBLISHED ON THE 2ND AND 16TH OF EACH MONTH
At No. 42 Pine Street, New York.

This is a recognized official organ of—
LIGHT, HEAT, STEAM, WATER-SUPPLY,
VENTILATION, SANITARY IMPROVEMENT,
AND GENERAL SCIENCE.

TERMS

SUBSCRIPTION—Three Dollars per annum, in advance.

AGENTS

NEW YORK—AMERICAN NEWS COMPANY, 119 and 121 Nassau S
BOSTON—S. M. PETTENGILL & Co., 6 State Street.
PHILADELPHIA—PRATT & Co., Corner 9th and Arch Streets.
Germany—B. WESTERMANN & Co., of New York.

SATURDAY, MARCH 2, 1878.

Official Report of Examinations of Gas for two Weeks ending Feb. 23, 1878, made at the Photometrical Room of the Department of Public Works.

Corrected Illuminating Power.

Date. Feb. 1878.	Time of Day at which Test were made.	New York Gas Light Co.	Manhattan Gas-Light Co.	Mutual Gas Light Co.	Metropolitan Gas-Light Co.	Harlem Gas-Light Co.	Municipal Gas-Light Co.
11	Between 10 A. M. and 3 P. M.	15.62	15.38	18.71	16.85	15.88	
12		15.88	15.52	18.52	17.05	15.77	
13		14.48	15.79	18.09	16.32	17.52	
14		16.99	17.28	18.34	16.53	16.84	
15		16.43	16.85	19.37	16.38	17.23	
16		16.86	15.74	19.07	17.15	16 92	
	Average	16.04	16.09	18.68	16.71	16.69	
18		16.32	16.88	19.91	16.65	17.15	
19		16.19	17.10	20.45	16.87	16.62	
20		16.41	16.99	19.77	16.21	17.42	
21		17.20	16.76	19.18	16.83	16.84	
23		16.53	16.16	19.73	16.54	16.14	
	Average	16.53	16.77	19.80	16.62	16.83	

Sugg-Letheby burner.
E. G. LOVE, Gas Examiner.

The new Suspension Bridge in Minneapolis was completed in 1877, under direction of T. M. Griffith. The span is 675 feet; towers, 111 feet high; roadway, 20 feet wide; foot walks, each 6 feet wide; platform, 40 feet above ordinary state of water. The cables for the main bridge are 9½ inches in diameter, those for the foot walks 4 inches in diameter. The strength of the cables is 10,996,000 pounds. Strength to floor stays, 440,000 pounds. The anchorage extends through limestone rock 10 feet thick. An additional protection is made by heavy masonry around each of the four anchors. Cost of the bridge and approaches, about $200,000.—*Eng. News.*

Correspondence

[Correspondents, in all cases, should sign their communications with their names and address in full—not for publication, unless desired, but as a guarantee of good faith.—ED

CEDAR RAPIDS, IA., Feb., 1878.

Mr. Editor: I send you the following account of the death by suffocation of three men in the Marshalltown Gas Works, on Sunday, September 30th, for your use, if you deem it of sufficient interest to your readers. On the day named above, Thomas Mannion, lessee and manager of the Marshalltown Gas Works, and John Eddling and Thomas Cummings, stokers, were found dead in the cellar of the purifying house, at two o'clock in the afternoon, by Mrs. Mannion, wife of the lessee. The three men spent the forenoon until about eleven o'clock, stopping leaks in the connections of the bridge pipes and dip pipes. About eleven o'clock they were seen to go into the purifying house, which was the last seen of them until they were found dead. The following verdict was recorded by the coroner's jury: "That the deceased came to their death by suffocation from coal gas, issuing from a drip cock, accidently opened and left open by one of their number in the cellar of the purifying house, at the gas works."

Afterwards, I was called upon to investigate the matter, and the following was the result:

On Saturday, the day before the accident, the water in the meter gauges began to "jump." The drip on the inlet main to the holder was tried and no water was taken. During the day the "jumping" in the meter continued to increase, and at night it "jumped" badly, as also did the lights in the retort house. On Sunday morning the holder was nearly "on the bottom," and it was found that it was not rising. The drip was tried, and with no better result than the day before.

The men now turned their attention to stopping the leaks in the bridge pipes and dip pipes, concluding that all the gas being made from the 400lbs. of coal in the retorts was being lost at those leaks. Those leaks stopped and the holder still declining to rise they went into the purifying house cellar, to investigate and there lost their lives by suffocation. The cellar was perfectly tight, without a particle of ventilation, with the exception that there was a small piece of board split off of one side of the trap door leading into the cellar from the floor above. Of course the "gas men" among your readers will have discovered before now the real cause of this sad catastrophe, which was this, *a defective drip pump.* Their "drip pump" was an old pitcher spout cistern pump, and had on it *a split coupling.*

They could not take the water from their drip, the drip filled, the main filled to such an extent that some time during the latter part of Saturday night or Sunday morning it shut off the passage of the gas entirely, and all the gas they made from that time on was forced through the hydraulic seals in the purifying house cellar, so that when they entered it they entered a gas holder, and very soon came to their death. In regard to the drip cock mentioned by the coroner's jury, I will say that it was on a drip pipe attached to one of the connecting pipes between centre seal and purifying box. It had no nut or washer on the end of its plug and could be turned by the slightest touch of the finger, and it probably was opened by a touch in taking the men out of the cellar, as it was within a foot of the ladder, and one of the men laid directly under it.

The first thing that was done after the finding of the men and their removal was to get a new pump and pump about a barrel of water from the inlet main and its drip.

Mr. Mannion was a gas fitter, doing business in Marshalltown, entirely unacquainted with the management of a gas works, with the exception of a few weeks that he had had this lease. When will capitalists cease to jeopardize their investments and the lives of their employees by putting the management of so precarious a business as the manufacture of gas into competent hands.

GEORGE A. FARWELL,
Supt. Cedar Rapids Gas Light Co.

On the Photometric Comparison of Light of Different Colors.

BY PROF. O. N. ROOD, OF COLUMBIA COLLEGE.

[Read before the National Academy of Sciences, Oct. 24, '77.]

The comparison of the intensities of light of different colors has long been considered one of the most difficult of photometric problems, but by the use of very simple means, I have recently made a series of measurements of this character, which may not be without interest to those whose studies lie in this direction. The luminosity of card-board painted with vermilion, was, for example, measured as follows: a circular disc of the vermilion card-board was attached to the axis of a rotation-apparatus, smaller circular discs of black and white card-board being simultaneously fastened on the same axis, so that by varying the relative proportions of the latter a series of grays could be produced at will.

The compound black and white disc was now arranged so as to furnish by rotation a gray which was *decidedly darker* than the vermilion; this gray tint was then gradually lightened, till the observer became doubtful as to the relative luminosities of the red and gray discs; the angle occupied by the white sector was then measured. Next, a gray decidedly *more* luminous than the vermillion was compared with it, and diminished in brightness till the observer again became doubtful, when a second measurement was taken. All this time the manipulation was performed by an assistant, the experimenter giving directions, but remaining in ignorance of the results to the end. The mean of ten such experiments assigned to the vermillion disc a luminosity of 23·8, that of white card-board being taken as 100. In this experiment and in all those that follow, proper corrections were made for the amount of white light reflected by the black disc, this having been previously ascertained, in a manner which will be described in a future communication.

In order to test the correctness of the final result, the luminosity of a blue green disc, correctly complementary in color to the vermilion, was next measured in the same way; it proved to be 26·56. The vermillion and blue-green discs were then combined, according to Maxwell's method, so as to obtain a pure gray by rotation, and the angular proportions of these colored surfaces, and the value of the gray in terms of white and black card-board, measured. The gray thus obtained had a luminosity of 24·54, that of white card-beord being 100. Next, the value of this same gray was *calculated* from the measured luminosities of the two colored discs, and the proportions of these colors required to produce a pure gray by mixture on the rotation apparatus; the calculated value was 25·47.

This agreement proves the correctness of the photometric comparison, and also of Grassman's assumption, that the total intensity of the mixture of masses of differently colored light is equal to the sum of the intensities of the separate components, which, so far as I know, has not before received an experimental confirmation.

Corresponding measurements were made with a green, and its complementary purple disc; also with a blue and its complementary yellow disc; the results are given below.

	Luminosity.	Gray (observed.)	Gray (calculated)
Vermillion	23·8	24·54	25·47
Blue-green	26·56		
Chrome yellow	80·3	54·51	53·92
Cobalt blue	35·38		
Green	41·19	24 94	26·56
Purple	14·83		

—*Amer. Jour. of Science and Arts.*

Iron Grinders.—Instead of millstones, chilled iron rolls are beginning to be used in England for the purpose of reducing wheat and other kinds of grain.

Cheltenham Fire Brick and Clay Retort Works.

The attention of glass manufacturers and those desiring a fine quality of gas retorts, fire bricks, and fire clay goods, is called to our superior facilities for producing this class of goods.

It is a well known fact that the Missouri fire clay is the *only* clay that has yet been discovered in this country that can successfully be used for glass house purposes. It competes favorably with the clays from the best known mines in the old world in all our markets, and in some respects is superior to them.

These qualities, together with its being a plastic clay, make it particularly desirable for the manufacture of gas retorts, crucibles, and the lining of furnaces, where fluxes are used for the reduction of ores.

We have also recently developed a non-plastic clay, specially adapted for refractory purposes, and which is fully equal in quality to any known in this country.

Being the largest miners of fire clay in this market, and manufacturing all grades of fire clay ware, we wish to impress upon the attention of consumers the fact that we use only the "cream of the mine" for gas retorts, and fire bricks and tiles. The ordinary and common grades of clay, which vitrify at lower grades of temperature, are used for making sewer pipes, and articles not required for high heats; and as we are large manufacturers of this class of goods, we are thus enabled to use each quality of clay for the purpose to which it is best adapted.

These facilities are enjoyed by no other manufacturer or shipper of fire clay in this market, and for this reason we are able to offer the very best goods at the lowest possible price, and buyers and consumers will find it to their advantage to consult us before ordering elsewhere.

The favorable position of our city as a distributing point, and the numerous railway lines leading to all points of the country, together with unrivalled water communication, give ample competition between the different freight lines, and customers can always rely upon our getting the very lowest shipping rates on all orders entrusted to our care.

EVENS & HOWARD.

St. Louis, February 1st, 1878.

NEW ORLEANS GAS-LIGHT COMPANY,
NEW ORLANS, March 13, 1875.

Messrs. EVENS & HOWARD, St. Louis—

Gentlemen:—Yours of the 5th inst. is received. We have been using your Cheltenham fire clay for five years, both for mortar and retort setting, tiles and blocks with great satisfaction. The blocks have stood as well as any of the numerous brands which we have tested.

We have also used your Cheltenham fire bricks for several years, and have found them to possess remarkable refractory power. In one instance an arch of these bricks, turned directly over the centre of a retort furnace, was taken down after having been continuously exposed to a white heat for 18 months, and the only sign of the ordeal was a slight glaze upon the surface. Every brick forming the arch was used in a new furnace.

Yours truly,
THEOBALD FORSTALL, Gen. Supt.

CHICAGO GAS-LIGHT COMPANY
CHICAGO, March 20, 1874.

Messrs. EVENS & HOWARD, St. Louis—

Gents:—In answer to yours of the 10th inst. I will say we have used your fire brick for over fifteen years, and have used your retorts for several years.

The seventy-five retorts now in use of your make are in good order, and taken together—brick, retorts and tile—give us satisfaction.

Yours truly,
PETER T. BURTIS,
Engr. and Supt. Chicago G. L. and C. Co.

ST. LOUIS, May 22, 1877.

Gentlemen:—Your retorts have been in constant use in our works for three years and ten months and promise to last for some time yet.

I will further state that our experience with your retorts justifies us in stating that they have far surpassed the representations made to us at the time of giving the order to you, and I cheerfully recommend your material to other gas works for its durability and perfect workmanship.

To EVENS & HOWARD, St. Louis.

JOHN F. MAGOVERN,
Vice Pres. Laclede G. L. Co.

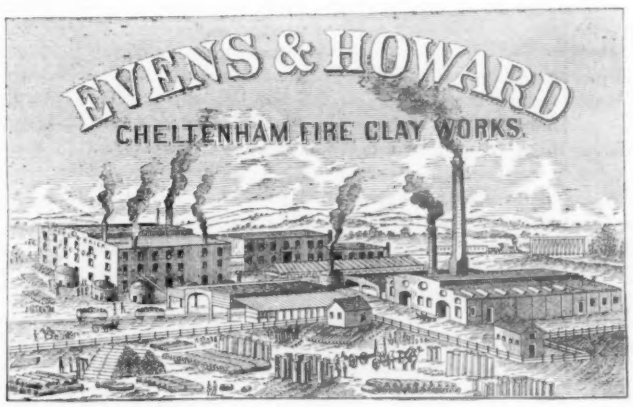
EXTRACTS FROM LETTERS OF T. G. OUTLAW, SECRETARY OF THE MOBILE, ALA., GAS CO.

MOBILE, ALA., Dec. 15, 1877.

* * * * These retorts of yours are the handsomest we have ever seen.

December 31, 1877.

* * * We are highly pleased with your retorts and will remember you with our future orders.



HOWARD STATION, March 26, 1875.

Messrs. ENENS & HOWARD, St. Louis—

Gentlemen:—We have used your fire bricks, tiles, etc., for several years past, and they have given us the very best satisfaction. We find them particularly desirable in the construction of lead and silver smelting furnaces, on account of their small contraction under change of temperature.

AUGUSTUS STEITZ, Metallurgist,
St. Louis Smelting and Refining Co.

CHILLICOTHE GAS-LIGHT AND COKE CO.,
CHILLICOTHE, OHIO, Jan. 12, 1878.

Messrs. EVENS & HOWARD, St. Louis, Mo.—

Dear Sirs:—Enclosed find Draft No. 82,500 on Central National Bank, New York, payable to your order, for Five Hundred and Twenty-three dollars, to pay your bill for retorts, etc.

If it is any satisfaction to you, I would say that I believe these to be the best lot of retorts and bench material that has ever been received by this company. Please acknowledge receipt and oblige.

Respectfully yours,
A. C. KOPP, Secretary.

PHILADELPHIA, May 3, 1873.

Messrs. EVENS & HOWARD, St. Louis, Mo.—

Gents:—In reply to your inquiries about the quality of your clay, for glass house purposes, we have to say, that having used your clay for crucibles for the past nine years, it gives better satisfaction than any we have ever used. While the German clay crucible would average four to six weeks, we find crucibles made of your clay to average nine weeks. We are using it in the patent Siemens' gas furnace, in open crucibles, 38 inches diameter and 33 inches high, holding about 1,200 pounds of glass, and the heat is higher than any furnace we have ever used and we would not be willing to risk any other clay.

In our present furnace we use about 3,000 degrees of heat for melting, and about 1,000 degrees after the glass is melted, or what we call "blowing heat."

We use altogether open crucibles, as we make only green and flint glassware, and cannot answer your inquiries in regard to the covered crucibles, except that they would last a much longer time, as we are satisfied there is no glass furnace run as hot as we do ours.

Of course it is necessary to prepare the clay well, and requires the same treatment as the German clay. Any crucible clay that is not properly mixed will not stand well. We assure you that we consider the selected clay from your mines superior to any other clay for our purposes.

Very respectfully,
BURGIN & SONS.

OFFICE OF THE HEMINGRAY GLASS COMPANY,
CINCINNATI, Nov. 16, 1875.

MESSRS. EVENS & HOWARD,
St. Louis, Mo.

Gents:—In reply to your inquiries about the use of your clay for glass pots, it gives us pleasure to be able to state that it is equal to any American clay we have used. We have had pots made of your clay that stood three months, and when taken from the furnace were still in fair condition. We consider your clay better than any German clay that we have been able to obtain for the last ten years. We use both open and covered pots. Yours truly,
HEMINGRAY GLASS CO.

PUTNAM GLASS WORKS,
ZANESVILLE, O., Jan. 12, 1875.

EVENS & HOWARD, St. Louis—

Gentlemen:—I have used your clay for glass pot purposss since about 1858, and consider it superior to any which I have tried. It gives me pleasure to recommend it to other glass manufacturers.

Yours truly,
J. W. CARTER.

OFFICE OF OMAHA SMELTING AND REFINING CO., OMAHA, NEB., Jan. 12, 1875.

Messrs. EVENS. & HOWARD, St. Louis—

Gentlemen:—In reply to your favor of the 3d inst., I will state that your fire bricks and dry milled fire clay have been used in our works for several years, and that we are very well pleased with both. Your bricks are especially desirable for silver and lead smelting furnaces, on account of their durability, compactness and small expansion and contraction under change of temperature. It gives me pleasure to recommend your material to other smelting works.

E. W. NASH, Treas. O. S. & R. Co.

HAMILTON, CANADA, 16th January, 1878.

Messrs. EVENS & HOWARD, St. Louis, Mo.—

Dear Sirs:—I am not acquainted with you, but well acquainted with your clay. I have been about glass factories for over thirty years. Your clay stands better in pots than any other clay I ever saw.

Yours truly,
THOS. H. SINDELL.

Naphthaline.

Sir: A short analysis of M. Brémond's paper, descriptive of his process for the prevention of the deposit of naphthaline by the desiccation of the gas, and a comparison of the same with Mr. Aitken's process of desiccating gases, will show wherein the two differ.

M. Brémond, after referring to the great trouble entailed by the deposition of solid naphthaline in mains and branch pipes, says that, up to the date of his researches on the subject, the only remedies proposed for counteracting the effects of naphthaline were all based either upon its solubility in tar—for example, by the prolongation of the contact of the gas with the tar—or upon its solubility in the oils of naphtha, petroleum, &c. He then asked the question, Are these remedies, when properly applied, sufficient to remove the naphthaline? And his answer is substantially to the effect that they are sufficient to remove the naphthaline produced in the retort during the process of destructive distillation; that, after the condensing and purifying apparatus have been passed, naphthaline does not remain in the gas—at least, in such quantities as to cause precipitation in the mains. But he says, further, although the naphthaline at this stage of the manufacture is removed, the precipitation of naphthaline in the mains, &c., is not prevented, for naphthaline is subsequently produced by synthetical reactions between some of the other hydrocarbons ordinarily contained in the gas, those reactions being due to the heat given out by the condensation of the aqueous vapours; or, at any rate, whatever may be their cause, those reactions do take place, because naphthaline is not deposited when the gas is entirely deprived of its water vapour.

The principal reason which M. Brémond assigns for the advancing of this new theory of the formation of naphthaline synthetically from some of the constituents of the gas, by the agency of the latent heat of the condensed water vapour, and for abandoning the idea of its pre-existence in the gas after its purification of the crystalline naphthaline which is deposited in the mains, &c., is, that if the crystallization is preceded by the condensation of the aqueous vapours contained in the gas, it obeys a law which might be thus expressed: In a mixture of several vapours, when one of these vapours attains its point of condensation it displaces the point of condensation of the vapour with which it is mixed. He says that, up till now, this law has been neither laid down nor verified, that he has submitted it to the judgment of experienced physicists, and that he is authorized to say it is at the present moment the subject of study by the learned professor of physics, the superintendent of the College of France.

In your editorial of Oct. 16, you indicated your doubts as to the truth of this theory of the synthetical formation of naphthaline from the constituents of the gas, and, to my mind, the experiments you advised M. Brémond to make would have very clearly proved the justness of your conclusions, and convinced M. Brémond that his theory was without foundation. I shall, therefore, not further refer to this part of his theory, but confine myself to proving that the law relating to the tension of mixed vapours, which he asserts has neither been laid down nor verified, is both well known and widely applied.

There is no standard work on physics which does not give Regnault's experiments on the tension of the vapors of mixed liquids. These experiments prove that—1, when two liquids exert no solvent action on each other, such as water and bisulphate of carbon, or water and benzole, the tension of the vapour which rises from them is nearly equal to the sum of the tensions of the two separate liquids at the same temperature—*i.e.*, that the vapours from such liquids act towards each other as permanent gases. 2. With water and ether, which partially dissolve each other, the tension of the mixture is much less than the sum of the tensions of the separate liquids, being scarcely equal to that of ether alone—*i.e.*, the limited solvent action of the vapours for each other prevents or counteracts their power upon each other as permanent gas. 3. When two liquids dissolve each other in all proportions, as ether and bisulphate of carbon, or water and alcohol, the tension of the vapours of the mixed liquids is intermediate between the tension of the separate liquids—*i.e.*, the vapours act towards each other as if they were the vapours of the same compound. The above is just the inverse of the law given by M. Brémond, which might be thus stated: 1. In a mixture of several vapours derived from substances having no solvent action on each other, the vapours act towards each other as permanent gases. When the temperature of the mixed vapours is reduced, the vapour having the lowest tension is precipitated from the other as from a permanent gas; a portion of the vapour having the lowest tension being held in diffusion by the vapours having the highest tension, till it reach the point of condensation, when the whole is condensed together. 2. In a mixture of several vapours derived from substances which dissolve each other in all proportions, when the temperature is reduced, a portion of the whole of the vapours is simultaneously condensed, the quantity of each being dependent on the difference in tension between the vapours and the relative proportions in which they are present. 3. A mixture of several vapours derived from substances which only partially dissolve each other, on being reduced in temperature follows in part the laws previously given, dependent on the proportion of each vapour present.

The above laws are verified in an endless series of processes. For instance, in the distillation of coal tar and paraffin oil, steam is injected into the distilled fluid, and, the hydrocarbon vapour not being soluble in the water vapour or steam, acts in a manner similar to an atmosphere of permanent gas; the tension of the hydrocarbon vapours being added to that of the steam, the mixed vapours pass from the still to the condenser at a temperature somewhat under the separate volatilizing point of the distilling fluid. The hydrocarbon vapour being held in diffusion by the steam, on the temperature and consequent tension of the mixed vapours being reduced, the hydrocarbon vapours are precipitated or condensed from the steam as from a permanent gas, not a trace of water vapour being condensed till the temperature falls so far as to lower the tension of the steam below that of the atmosphere, when the whole steam and remaining vapours are condensed together.

Again, as an instance of the action of the vapours of substances which are soluble in each other, take the distillation and preparation of absolute alcohol from fermented liquors. The boiling-point or tension of the vapour from the mixed alcohol and water is intermediate between the two tensions of the separate vapours and, as a matter of course, varies with the proportions in which the liquids they are derived from are present in the still; but, however, small the quantity of alcohol, and however large the quantity of water, or *vice versa*, alcohol and water will simultaneously distil together. On the tension of the mixed vapour being reduced in the condenser, the water vapour, in accordance with its lower tension, is first precipitated, but it invariably carries with it a small quantity of alcohol, dependent upon the relative quantity of vapour of alcohol and water present. Hence, the reason why two separate fluids, which are soluble in each other, require such a number of fractionations before they can be obtained pure, and why, in some cases, substances having a stronger affinity for one of the soluble substances have to be employed to remove the last traces—as in distilling alcohol over quicklime, which has a strong affinity for water, to remove the last traces of that substance. Those two processes illustrate the difference in the action of vapour *per se* derived from substances which do, and from those which do not, dissolve each other, and are sufficient to show that vapours, when mixed, affect the tension of each other. But perhaps the best illustration of the application of the laws relating to the tension of mixed vapours, when a very complex mixture of gases and vapours are to be arranged in groups, and separated by means of condensation, or the lowering of the vapour tension, is given in the condensation of coal gas.

The crude gases and vapours, as they enter the hydraulic main, may be divided into two groups—those substances which the manufacturer desires to retain as permanent gas, and those which he wishes to eliminate. To the former group belong the hydrocarbon gases and vapours of the volatile hydrocarbons; to the latter, the denser hydrocarbons and sulphuretted hydrocarbon compounds, which are solvents for the former in nearly all proportions; also water vapour, ammonia, carbonic acid, sulphuretted hydrogen, &c. The gas manufacturer has learned that to very suddenly cool his crude gases and vapours he reduces the illuminating power of the gas, the reason being that when the whole of the vapour tensions are reduced simultaneously and quickly, the solvent action of the denser hydrocarbons is allowed full play, and they, therefore, reduce the vapour tension of the volatile hydrocarbons absorbed, and remove them as tar. To prevent this action, the gases and vapours are cooled very slowly, in order that the vapour tension of the solvent denser hydrocarbons may be reduced first, thereby causing them to be precipitated at a temperature which will lower their solvent action as much as possible, and allow the gases to retain the vapours of the volatile fluids in diffusion.

But, however, slowly the cooling may be effected, it will only modify the solvent action of the denser hydrocarbons to a limited extent. The slow cooling resembles a single distillation of alcohol and water. To entirely separate alcohol and water, it is necessary to subject them to a series of fractional distillations and condensations; and, for a similar reason, to separate the volatile hydrocarbons from the denser, it is necessary that they be similarly distilled and condensed. Mr. Aitken's process for the condensation of crude gas is, as you are aware, based upon this mode of treatment. Careful fractional condensation will only separate the vapours of low tension; the vapours and gases having a high tension, which it is desired to eliminate, cannot be removed by condensation without simultaneously removing the hydrocarbon vapours of high tension, which it is desired to retain in the gas. Other physical or chemical means must, therefore, be employed to eliminate these compounds. Thus water, which has very feeble solvent action on the hydrocarbons, but a powerful affinity for ammonia, is employed to remove that gas. This water may be applied to the gas either in the liquid or gaseous form, as when the steam-scrubber is employed. When used in the latter form, we have again brought into play the law relating to the tension of mixed vapours and gases. Water in the gaseous form having no solvent action on the hydrocarbon vapours, acts towards them as if it were a permanent gas, the hydrocarbon vapours being diffused through the steam in similar proportion to that in which it is through the other permanent gases. Should the mixed vapours of steam, hydrocarbon vapours, and gases be very quickly cooled, the water vapour is in great part instantly precipitated, and the portion of the hydrocarbon vapour which was held in diffusion by it, not having the necessary time to transfer itself to the permanent gas, is also precipitated. Slow cooling allows this exchange to take place, and only the hydrocarbons, due to their limited solubility in water, and precipitated with the precipitated steam-water along with the ammoniacal gas. Here also we have illustrated the enormous effect of the water vapours when their tension is reduced to the liquefying point, causing a very large reduction of the vapour tension of ammoniacal gas or vapour.

The gaseous sulphuretted hydrogen, carbonic acid, and sulphuretted hydrocarbon compounds, being absorbed by hydrate of lime and its salts, the only matter now remaining in the purified gas, not eliminated, is water vapour. As the presence of this water would

cause, by its sudden condensation, the precipitation of a portion of hydrocarbon vapour. Mr. Aitken proposes to remove it by the chemical affinity of oxide of calcium, or quicklime, for water; and by thus removing the water vapour at a comparatively high temperature, the hydrocarbon vapours are left in diffusion in the permanent gas.

Admitted, then, that naphthaline is produced only at high temperatures and in the retorts, it is evident that any process which would absorb or dissolve it out of the crude gases, during the process of condensation, would, according to Mr. Henry Aitken's views, obviate any necessity for the employment of a desiccating process, and that it would only be in the event of some form of condensation being employed which would prevent the naphthaline and other hydrocarbons from being removed that a desiccating process would be required.

Now, the process of Mr. Henry Aitken is just such a one. Instead of allowing the tars and gases to cool together, and thereby allowing the tars to absorb the naphthaline, as also necessarily a quantity of the vapours of the other volatile hydrocarbons, he removes the tars proper from contact with the gases whilst hot, and, by a fractionating process of cooling, saturates the gases to the fullest extent with the vapours of the most volatile hydrocarbons; and to enable the gases to retain those procipitable vapours, he dries them by passing them through lime; and, mark the reason why—because he had learned, by experiment and observation, that when watery vapour was condensed and precipitated, a portion of the hydrocarbon vapours which he wished to keep in the gas was simultaneously condensed and precipitated.

Mr. Aitken does not desiccate the gases to prevent the precipitation of naphthaline alone, but from the first he has, to my knowledge, all along held that his process would prove a complete cure for the nuisance of naphthaline deposit; for the double reason that the denser naphthaline would be, so to speak, fractionated to the proper point out of the gases by the improved form of condenser, and there would also be diffused through the gas an extra quantity of the vapours of the liquid hydrocarbons, which act as solvents for solid naphthaline.

In short, the points of difference between the two processes are these: Mr. Aitken's patented process is founded upon laws, and upon results which have fully verified those laws; while that of M. Brémond, on the other hand, is founded upon what is evidently an error, and for the prevention of that which does not take place—viz, the precipitation of naphthaline, which has been produced synthetically, from certain constituents in the gas, by the agency of the heat given out by the condensation of aqueous vapours.

Had M. Brémond given more careful thought to the extract of the report to the Board of Trade by the London Gas Referees, which he gives in his paper, it would have saved him from committing the blunder he has made, for it is there pretty clearly indicated that the presence and mode of condensing aqueous vapours from coal gas has an effect upon the condensing point of the other hydrocarbon vapours suspended in the gas. And a perusal of Mr. Aitken's specification would have shown him that he was committing a further blunder in attributing to Mr. Aitken any desire to lay claim to the discovery of the fact that the presence of aqueous vapour in gas reduced its illuminating power, the fact having been known long previous to the date of the report of the London Gas Referees, that water vapour reduced the illuminating power not only in the manner alluded to by "Selenium" in your issue of Dec. 11, but also by its undergoing decomposition during the combustion of the gas; the oxygen of the aqueous vapour combining with, and consuming, the carbon of the hydrocarbons at a temperature below that of incandescence, and thus also reducing the luminosity of the gas. Mr. Aitken makes no such claim. What he does claim to have discovered, or at least to have been the first to apply, is the fact that by desiccating gases they will sustain being exposed to a much lower temperature without a precipitation of the hydrocarbon vapours taking place.

William Young.

Clippens Oil-Works, Paisley, Dec. 19, 1877.

—*London Journal of Gas Lighting.*

Gas-Light Intelligence.

OUR EXCHANGES.

[*From the Coal Trade Journal.*]

United States.

Price of Gas in Sharon, Pa.—Sharon, Pa., pays $2.25 per thousand for gas-light.

Consumers Mutual of Baltimore.—The Consumers Mutual Gas Co. of Baltimore, Md., began business on the 6th, gas being turned on on that date.

Electric Light in Chicago Tunnel.—They are talking in Chicago of lighting the tunnels with electricity, and expect to make a great saving by it.

Price of Gas in Galena, Ill.—Galena, Ill., pays $4 per thousand for gas. Coal used is Youghiogheny, via Cincinnati, and costs $6.70 delivered per 2000 lbs.

Natural Gas in Ohio.—At East Liverpool, Ohio, contracts have been made for the boring of four more natural gas wells. The various uses to which this gas has been applied continues to excite the wonder and astonishment of all visitors to this town.

New Gas Co. at Columbiana, O.—Among the certificates of incorporation recently filed with the Secretary of State at Columbus, Ohio, was that of the American Hydro-Carbon Gas Company of Columbiana, with a capital of $100,000.

Kerosene in Macon, Ga.—In Macon, Ga., it is proposed to use kerosene lamps placed in locomotive head-lights for illuminating the city. It is claimed that one such light would show for a distance of fifteen hundred feet.

The New Tarif on Coal.—The proposed tariff keeps coal at its old rating. "Coal slacked and culm, such as shall pass through a half inch screen 40 cents per ton of twenty eight bushels, eighty pounds to the bushel; coal, bituminous, and shale, 75 cents per like ton."

French Opinion of Coal Combination.—*Le Charbon*, the French coal paper, in commenting upon the combination of the anthracite companies, says: "We admire the practical superiority of the American race, but we cannot admire a mode of procedure which is against the most normal ideas of modern political economy."

Price of Gas at Whitehall, N. Y.—The Whitehall (N. Y.) Gas Light Co. have fixed the price of gas at the following rates: For consumption of 100 to 600 feet per month, $4 per 1000; for consumption of 600 to 1,500 feet per month, $3.50 per 1000; for consumption of 1,500 feet and upwards per month, $3 per 1000. The company hope, that by an increased consumption, they will be able to keep the price down. Street lights, $35 per lamp per year.

Gas Making in Passaic, N. J.—A suit is pending in the Passaic County (N. J.) Court between the gas company and the city of Passaic. George Denholm, an expert, and one of the employees, testified that the cost of manufacturing gas in that city by that company, counting all the leakage and waste and other incidental expenses, in addition to the material and labor, was about $2 per 1000 cubic feet. They furnish gas to the public at $3.25 per 1000, with a discount of 5 per cent. for prompt payment, which makes the price $3 net. Mr. Denholm also testified that it could be made considerably cheaper if they made more.

Northern Liberties Gas Co., Philadelphia.—The Philadelphia *Record* of the 5th had the following: The trustees of the Northern Liberties Gas Works use on an average 40,000 tons of coal a year, about one-half consisting of the New Pelton coals of England, which are shipped from Newcastle-on-Tyne. Experiment has shown that a mixture of these coals with those from Westmoreland county, in this State, produce a light equal to that furnished by the Philadelphia Gas Works, and a stronger fuel. The latter merit has reference to the coke which is left after distillation, and is an important consideration in the manufacture of gas, from a financial standpoint, as it is by this principally that the retorts are heated. "The reason for sending to England for coal, beyond those of good light and fuel," said an officer of the Northern Liberties Works, yesterday, in discussing the subject, "is because we can get it at a much lower rate than that charged here. During the last two years we have been receiving it from seventy-five cents to a dollar cheaper per ton than Pennsylvania coal. The coal we are now getting from England costs us $4.90 per ton, while the Westmoreland coal costs $6.50. The prices on the former vary, of course, according to the value of gold, as the duties and freight are paid in that coin. We buy coal wherever we can get it at the cheapest rate, and Pennsylvania interests should not have such high rates. There is no reason why they should charge $0.75 per ton for bringing coal from Westmoreland county to the city, when we can get it from England at a much lower figure."

[*From Engineering News.*]

Price of Gas in Springfield, Ohio.—The Springfield, Ohio, Gas Company has voluntarily reduced the price of gas from $3.25 to $2.90 per 1000 feet.

Gas in Galveston.—Alfred F. James, Ephraim McHean, and their associates, have been authorized by the city council of Galveston to supply the city with gas for twenty-five years.

The Street Lamps of Cincinnati.—The Cincinnati *Daily Gazette* says: "With the approval of the Mayor and Board of Public Works, the street lamps of Cincinnati will be lighted all night until the 1st of March, after which the moon will resume her office."

The Municipal Gas Question.—The Allehany (Pa.) Gas Committee has decided to take a vote on the municipal gas question. The gas company claim that the city has forfeited its right to purchase the twenty years having expired five years ago.

Gas for the State House at Illinois.—The Illinois Coal and Gas Co. have entered into a contract to furnish gas to the State House at $2.65 per 1000, and propose to commence the erection of works for the purpose at once. It is said that to prevent this, an application will be made for an injunction to stay proceedings.

Testing a Gas-Holder at Indianapolis.—In Indianapolis, on the 5th ultimo, a test of the new gas company's holder, and of the mains, was made by atmospheric pressure, and the superintendent reports it a highly satisfactory one. The works are now ready for the manufacture of gas, and as soon as a few preliminary matters are arranged operations will commence.

Protest by the Dayton (Ohio) Gas-Light and Coke Co.—The Dayton (Ohio) Gas-Light and Coke Company protest against the recent action of the council in granting the Citizen's Gas Co. the right to lay a pipe across Main street, claiming exclusive privileges under a resolution adopted by the city council in 1848. The Citizen's Gas Co. acknowledgs the resolution but deny the power of the council to grant such exclusive franchise. The aid of the courts will probably be necessary to solve the question.

The Springfield (Ill.) Gas Co. in Trouble.—Trouble brewing in regard to the letting of the contract for gas works, at Springfield, Ill. The chairman of the Gas-Light Committee has opened the bids and submitted them to the public, before submitting them to the council, and has even gone so far as to indicate his official preference through the columns of the

press. This preference does not seem to be the lowest bid. The usual amount of charging and retraction will probably take place.

PERMISSION TO ERECT GAS WORKS AT HYDE PARK, MASS.—From the Boston *Daily Advertiser* we learn that "the selectmen of Hyde Park, Mass., have granted G. C. Winsor and others permission to establish gas works and lay pipes in the public streets of the town, provided the work is commenced within one year. The center of the town has for many years been supplied with gas by the Dedham and Hyde Park Gas-Light Co., whose works are at Dedham, at the rate of $4.50 per 1000 feet. The new company, of which Mr. G. C. Winsor of Boston, is president, will be known as the Hyde Park Gas-Light Co. The gas is to be made from crude petroleum, by the same process which is in operation in Philadelphia and several other Western cities, and is to be supplied at a cost of not over $2.50 per 1000 feet. Work is to begin in the early spring, and pipes will be laid throughout all sections of the town."

CONSUMER'S GAS CO. OF BALTIMORE.—The works of the Consumer's Gas Co. of Baltimore are located at Canton, and are the largest yet constructed to manufacture gas by the Lowe process. The works are capable of producing 1,000,000 feet per day, and consist of eight generators, two boilers, two 20 horse power engines, a 549,000 feet gasometer, and all necessary tanks, condensers, pipes, etc. It is stated that the works have been sometime completed, but that the cast iron pipe contractors, Messrs. McNeals & Archer, of Burlington, N. J., have failed to turn them over to the company, because of $187,000 in stock and $10,000 in bonds still due them. On the 12th January the engineer of the company, Mr. F. H. Hambleton, took possession of the works for the company, barricaded the gates and took other measures to prevent the contractors from regaining forcible possession. At last advices he still held the fort. In the meantime negotiations are progressing for a definite settlement, the gas company having acknowledged the justness of the claim of McNeals & Archer.

THE PURCHASE OF THE ALLEGHANY GAS WORKS.—The vote on the proposition to buy the Alleghany gas works was strongly in the negative as will be shown by the returns from a few wards and districts. In the Thirteenth ward it was, for 29 against 111. In the Eleventh, 2 for; 119 against. In the Ninth, 7 for; 112 against. First district, Third ward, 21 for; 75 against. Third district, First ward, 10 for; 111 against. Second district, for 13; 94 against. Total for, 245; against, 3,574.—*Pitts. Telegraph.*

ALLEGHENY VOTES NOT TO PURCHASE GAS WORKS—In Allegheny (Pa.) the people have rebuked not only the cliques that presume to dictate to the voter, who fix the slates and expect the people to endorse *their* judgment, but that august body supposed to represent the wisdom of Allegheny (Councils) has been snubbed. Almost to a man they favored the purchase of the gas works. Well, the people do not favor the purchase, and have uttered the most emphatic "No!" that could be proclaimed through the ballot-box. In this matter then, so far as Councils are concerned, it was a clear case of misrepresentation. The curve is pronounced, and the edge sharp. So sharp that it can "cut and come again."—*Pitts. Even. Chronicle.*

GAS MATTERS IN BALTIMORE.—The Baltimore Gas Light Company now advertises gas at $1.50 per thousand feet, and the *American* says this result has been brought about by competition.

The Consumers' Mutual Gas Co. of Baltimore, Md., began business on the 6th ult. On the 14th impelled by the action of the Gaslight Company in reducing its rates to $1.50 per thousand, they issue a card to the public, stating that they are ready to co-operate with the public in securing for the future a supply of first quality illuminating gas at $2 per thousand, with 5 per cent. off on prompt payment, say $1.90 net. If the citizens do not co-operate they disclaim responsibility for the consequences, and hint that when competition is carried too far it becomes destructive and ultimately results disastrously to the public. They will adhere to the rates given and refuse to cut.—*Exchange.*

On a Rapid and Accurate Method of Estimating Sulphur in Coal Gas.

[Communicated Article to the London "Journal of Gas-Lighting, January 29, 1878.]

BY MR. W. C. YOUNG, F. C. S., ETC.

[Public Analyst for the Poplar District, and Gas Examiner at Beckton to the Corporation of the City of London, and to the Metropolitan Board of Works]

The process in use at the testing-places under the control of the Gas Referees, for the estimation of sulphur in coal gas, although giving accurate results in the hands of experienced operators, is attended by so many difficulties, and takes so much time for its completion, that it is not surprising that a general wish should be felt for some means which would enable gas managers, without special training, to obtain equally accurate results, with the same apparatus, in a very much shorter space of time.

The process about to be described is based upon sound chemical principles, gives more accurate results than the one commonly in use, takes a very short time to complete, and, moreover, the chances of error are so slight, that a person of ordinary intelligence would obtain, for all practical purposes, as perfect results as the most experienced chemical manipulator.

Before proceeding to details of the method, and in order to explain its principle, it is necessary to consider the nature of the substances to be dealt with.

In the liquor given by the Referee apparatus, there are present carbonate of ammonium and sulphate of ammonium. Before converting the latter compound into sulphate of barium, it is necessary to decompose the former, which is effected by boiling the liquid with an excess of hydrochloric acid, chloride of barium being afterwards added. There is then present the excess of chloride of barium, hydrochloric acid, chloride of ammonium, and sulphate of barium.

Now, as hydrochloric acid and chloride of ammonium are readily volatile, whereas chloride of barium is not, it follows that, if the quantity added of the latter be known, then the amount left, after volatilizing the two former, must be the excess of chloride of barium added, the difference being clearly due to the chloride of barium required to decompose the sulphate of ammonium.

The chlorides admit of easy estimation; indeed, the process by which it is effected is at once the most accurate and simple in the domain of volumetric analysis; so that we have in this way a ready indirect means of ascertaining the amount of sulphate of ammonium contained in the liquor given by the Gas Referees apparatus.

My mode of applying this principle is as follows: The apparatus is used in the ordinary way, excepting that an upright eduction-tube twelve inches long is employed, in order that the bulk of the liquor obtained may be small. If ten cubic feet have been burned, the liquor and washings are made up to 500 septems (half a deci-gallon), well mixed, and 25 septems (1-20th part) measured by a pipette for the experiment. To this is added a slight excess of acetic acid (two drops is generally sufficient) and 10 septems, measured by a pipette, of a standard solution of chloride of barium, containing 1625 grains in one gallon. The whole is then transferred to a shallow flat-bottomed platinum capsule, and evaporated to dryness over a burner. The evaporation can be conducted over an Argand or rose Bunsen burner, the heat being adjusted so as to keep the liquid just below boiling, and so prevent possible spurting; but, where a number of estimations are being made simultaneously, it is best done on a water or steam bath. After evaporating to dryness, the residue is gently heated until the crucible is at a slight red heat; it is then cooled, and the contents washed out with water into a small beaker. To this solution an excess of a solution of yellow chromate of potassium is then added, and a standard solution of nitrate of silver, containing 531·2 grains per gallon, is added from a burette containing 50 septems (graduated into fifths of a septem), until a permanent change of tint is observable on shaking the liquid.

Each septem left in the burette indicates one grain of sulphur per 100 cubic feet of gas, and each division ·2 grain.

As many of those for whose benefit this process is intended may be unacquainted with the use of a standard solution of nitrate of silver for estimating chlorides, a few words explanatory of the process may not be out of place here.

When a solution of nitrate of silver is added to a mixture of soluble chromate and chloride, there is produced at first a deep red precipitate of chromate of silver, which is immediately converted into the white chloride of silver, the color at once disappearing. This action goes on until the whole of the chlorides present have been precipitated, and then the deep red chromate of silver formed is unaffected, and so marked is the change in the color, that one drop in excess of the standard solution of nitrate of silver employed in my process produces such a decided red tinge, that no one could be mistaken. This one drop would introduce an error of less than ·2 grain of sulphur per 100 cubic feet of gas.

The process of evaporation, as directed, takes at the most fifteen minutes, the rest of the work needing a few moments more, and as the result must necessarily be at least as accurate as that given by the tedious gravimetric method, the process will, I have no doubt, commend itself to those who desire to know in a short time the sulphur contained in the gas under examination.

Moreover, should the result of a test appear at all extraordinary, it can readily be checked by a repetition, or by a separate gravimetric estimation, as only a very small quantity of the liquid is used.

Should the gas contain more than 50 grains of sulphur per 100 cubic feet, it will be necessary to make the bulk of the liquor up to one deci-gallon (twice the quantity before directed), proceed as usual, and multiply the number of septems of standard nitrate of silver solution remaining by two, to find the amount of sulphur present.

If a "short" test is desired, one-half of a cubic foot should be burnt, when, if the whole of the liquor be taken, the number of septems of standard nitrate of silver solution remaining will indicate the number of grains of sulphur per 100 cubic feet,

Gas Examiner's Laboratory, Beckton Road,
North Woolwich, London, E., Jan. 21, 1878.

Dynamo-Electric Apparatus.

At the Meeting of the Institution of Civil Engineers, on Tuesday, the 22d inst.—Mr. Bateman, President, in the chair—the paper read was on "Some Recent Improvements in Dynamo-Electric Apparatus," by Dr. Higgs, Assoc. Inst. C. E., and Mr. Brittle, Assoc. Inst. C.E.

In a brief review of the rise and progress of this branch of electricity, the authors stated that the practical application of Faraday's important addition to electrical knowledge appeared in the first magneto-electric machine, constructed in 1833 by Pixii, and subsequently improved by Saxton and Clarke. The use of machines of large size, driven at high speed, was suggested by Professor Nollet. In 1854, Dr. Siemens, of Berlin, introduced the Siemens armature. The principle of accumulation by successive action, by combining two cylindrical armature machines, was due to Mr. Wilde. All these magneto-electric machines were disadvantageous in use, because their effect did not increase with their dimensions. In 1867 Dr. Siemens patented a machine to obviate rapid reversals. The step from magneto-electric to dynamo-electric machines originated with Dr. Siemens, Sir Charles Wheatstone, and Mr. S. A. Varley, the priority falling to the former. In the Siemens machine a peculiar method of winding the wire on the armature, devised by Mr. Von Hefner Alteneck, was employed. In the Gramme machine, a principle was adopted which had been described by Pacinotti in

1863, of whose apparatus the present Gramme machine was a modification.

A description was then given of the latest construction of Siemens Dynamo-Electric Machine and Electric Lamp, the latter devised specially for lighthouse illumination, and similar lamps were about to be supplied for the Lizard Lighthouse. The dimensions, weights, number of revolutions made by the cylinder, light equivalent in normal candles, and horse power required for driving, were, for three sizes of machines:

Dimensions in Inches			Weight in pounds.	Revolutions of Cylinder.	Candles Light.	Horse Power.
Length.	Width.	Height.				
25	21	8.8	298	1100	1000	1½ to 2
29	26	9.5	419	850	4000	3 to 3½
44	28.3	12.6	1279	480	14800	9 to 10

In the application to lighting purposes, the improvements in the present dynamo-electric machines were obvious. The magneto-electric machines first employed in lighthouse illumination, as pointed out by Dr. Tyndall, bore a cost of 10 to 1 as compared with the latest dynamo machine; while the cubic spaces occupied were as 25 to 1, and the weights as 13 7 to 1, the total light-power produced for the condensed beam of light being as about 1 to 5. Thus, with a cost 10 times, with a weight 14 times, and a volume 25 times that of the latest construction, the old machine produced one-fifth of the light, with an expenditure of practically the same driving power.

The results of the experiments with the electric light apparatus by Captain Abney, R.E., at Fort Monkton, in July, 1875, were given; but a more instructive series were contained in the Trinity House Report, on the "Comparative Trials of Electric Light at the South Foreland," from August, 1876, to July, 1877.

An important factor in the light efficiency of a given machine was the resistance of the circuit leading to the lamps. Experiment indicated that, to obtain a maximum of light, the resistance of the conducting wires should be proportioned to that of the machine In the use of dynamo or magneto-electric machines, the chances of stoppages had been quoted as a serious disadvantage; but these chances had been so reduced as not to exceed those arising with machines generally. The Trinity House Report stated that the "No. 68 Siemens machine worked well from the 7th of March to the 7th of April, without any necessity for a stoppage. On the 11th of March the commutator plates and brushes were adjusted; on the 19th the brushes were renewed; on the 28th the commutator plates and brushes were again adjusted; and on the 6th of April the commutator plates and brushes were renewed. The duration of the light, owing to required renewal of carbons, was limited to a certain number of hours, dependent on the size of the carbons and the machine employed.

Much excitement had been evinced as to the probable competition between gas and electricity, as sources of light-power. Although, under certain circumstances, these two agents undoubtedly came into competition, they had two separate fields. Hitherto gas had been employed for lighting spaces of both large and small dimensions, because a better source of light for large spaces had not been procurable with economy. But for lighting large spaces not subdivided by opaque objects or screens, it was a want of economy to employ gas. Assuming light power proportional to horse power expended, one hundred horse power would give 150,000 candles light; distributed from three points, the cost would not be more than £1 2s. 6d. per hour, each light centre giving an illumination which would enable small print to be read at a distance of a quarter of a mile from the light. A burner giving the light of 20 candles consumed six cubic feet of gas per hour which might be manufactured at a cost of 2s. per 1000 cubic feet. This gave 7,500 burners light only, and 45,000 cubic feet of gas, at a cost of £4 5s. per hour, a ratio of 4 to 1 in favor of electric lighting The economical ratios differed greatly, being dependent chiefly upon the price of gas and of the motor power employed. For large spaces the cost of electric lighting was about one-fourth, or even one-fifth that of gas-lighting, when steam had been used as power, and wear and tear were reckoned. With a gas-engine as motor, the ratio had only been as 1 to 3, the greatest economy having been with a turbine as a motor. At M. Dieu's workshops at Davours, the cost per hour for gas was 2s. 0·632d. against 1s. 7·2d. for electric lighting. M. Ducommun found, taking into account wear and tear and interest, that gas cost 2·25 times more than the electric light, which ratio was increased to 7·15 when wear and tear and interest were left out of consideration. At Messrs. Siemens Brothers Telegraph Works the economy was as 2 to 1 in favor of electric lighting. If, however, the ratio of light intensities were adopted as the ratio of efficiency, the advantage would be considerably higher (20 to 1) in favor of electric lighting. It might be laid down, as proved by experience, that for lighting large spaces, not too much subdivided, the advantage was greatly in favor of the electric light; but that where numerous light-centres of small intensity were required, or where the space was much subdivided, the advantage was in favor of gas. This advantage would cease when a practical method of subdividing the electric light was obtained.

The limit set by distance to the transmission of power by means at present adopted, had been comparatively narrow. Hydraulic power had been the most adaptable, with, however, several important disadvantages. Although electricity as a means of transmission was also limited by the distance to be traversed, the limit was in this case much more extensible, and under favorable instances practically disappeared. For the transmission of power, say from a stream or water motor initially, the following system was adopted:

First, a strap or belt from the motor was carried to the pulley of the driving dynamo-electric machine which generated the current. By leading wires of the required length, the electrical current generated in the first machine was conveyed to the terminals of a second and precisely similar machine. Thus the first machine generated the current which was utilized in imparting motion to the second machine. The greatest work was yielded by the second machine when the strength of the current given by the first machine or source had been reduced to one-half, by the induced current from the second machine. Supposing two equal machines arranged for the transmission of power, the amount of work reclaimable from the second machine would be 50 per cent. of that employed upon the first, and the number of revolutions of the armature of the second machine corresponding to the maximum of work reclaimed, would be half the number made by the first. Experiments also proved that the loss of efficiency was proportional to the added resistance.

The employment of the currents of magneto-electric machines for electrotyping and electroplating had long superseded the voltaic current. It was, however, only on a large scale that the current from a dynamo machine could be used with advantage. For small electro separations, or depositions, magneto-electric machines had been constructed. For the deposition of large quantities of metal, where by changing baths in succession, little change was made in the total circuit resistance, the dynamo machines gave much greater economy. With one of these machines, and a proper succession of vats, as much as three tons of copper had been deposited daily.—*London Journal of Gas-Lighting, Jan. 29th*, 1878.

A New Method of Rendering Glass Opaque.

The various methods now in use for rendering glass opaque, are, first, painting or covering one of the faces with any opaque white substance, such as alabaster, barytes, etc., mixed with oil. Second, causing the surface to be attacked by hydrofluoric acid. Third, covering the surface with ground glass in powder, and submitting the whole to vitrification at temperatures low enough to cause adherence of the powder without producing deformation of the sheet. Fourth, grinding the surface with emery. Fifth, abraiding it by the sand blast; and sixth, depositing thereon a salt in crystalline form.

A new process has recently been devised by M. Aubriot, by means of which he produces so-called muslin glass, of a great variety of colors. He proceeds as follows:

After carefully cleaning the surface a layer of vitrifiable color is laid over it. The vehicle is simply gum water, and care is exercised that that the pigment is evenly applied. The glass is then submitted to a mild heat until the water has evaporated, when a stencil of the desired pattern is laid over the surface, and a stiff brush is used to remove the loose pigment from the parts which are to be transparent. The glass is next inclosed in a frame, and above it is extended a piece of tulle, or, if desired, embroidered lace, the embroidery in the latter case being so disposed as to harmonise with the ground pattern previously made. The whole is then hermetically closed in a box, which contains in its lower portion a reservoir in which is a certain quantity of dry color in the form of impalpable powder. This, by an air blast, is blown evenly upon the glass, and adheres to the latter wherever the surface is not protected by the threads of the lace. In this way the pattern of the latter is defined. In order to fix the powder, the sheets of glass are placed in a steam chamber, where the steam moistens the gum and causes the powder to adhere. The color is then burned in a special furnace. By using different colors, it is said that very beautiful designs can be produced in this way, opaque or transparent, according as the pigments themselves are the one or the other. Remarkable effects also are obtained by the superposition of the tints.—*Furniture Gazette.*

The Richest Man in the World.

If money be power, says the *Whitehall Review*, what a force is J. W. Mackay, who, thirty years since, was a penniless boy in Ireland. Twenty years ago he traveled through the United States as a speculative salesman, and sixteen years ago he was a bankrupt. To-day, at the age of 45, Mr. Mackay owns three-eighths of the great Bonanza, the richest silver mine that has ever yet been discovered, and draws out of Nevada a yearly income of £2,750,000, which is the interest at five per cent. on a capital of £55,000,000. Though comparisons are odious, it is curious to note the difference in the incomes of four of the richest men on earth:

	Duke of Westminster.	Senator Jones of Nevada.	Rotschild.	Mackay.
Capital....	£6,000,000	£20,000,000	£40,000,000	£55,000,000
Per year..	800,000	1,000,000	2,000,000	2,750,000
Per month	60,000	80,000	170,000	200,000
Per day...	2,000	3,000	5,000	7,000
Per hour..	90	120	200	300
Per minute	1 10	2	4	5

Mr. Macay's fortune increases £5 every minute. The question is, What will he do with it? Or, perhaps, it would be more cautious to ask, What will it do with him? Fortunes in the far West often vanish as rapidly as they are acquired. Mr. Mackay has a magnificent hotel in Paris, where his family resides, while he passes most of his time in the neighborhood of his vast interests. Mr. and Mrs. Mackay passed the summer at Tourville, in the charming Villa Cordier, which stands on the hill above the town and overlooks the sea.—*Gas Trade Circular and Review.*

Prices of Gas Coal.

In our issue of Sept. 3rd, 1877, we noticed the fact that some of the larger gas companies of New York City had made contracts for their supplies of Westmoreland and Penn. coal, to cover their requirements up to March, 1879; the quantity so contracted for was 275,000 tons, the price $5.50, delivered in New York; those contracts were made under a *special freight* arrangement with the Penn. R. R., which *limited* the quantity to be *then* sold, as above stated; until within a few days the coal Co.'s have declined to

sell new applicants at the same terms; but it is announced, however, that $5.50 will be the price for *all* New York Consumers, for the year 1878, and some additional contracts have been made at that price, this fixes the quotations for Westmoreland and Penn coal for New York. No intimation has been made yet as to the probable course to be taken relative to the New England Market; the attempt of last year to compel that section to pay a higher proportionate price for the same coal than New York paid, has resulted so disastrously to the Penn and the Baltimore & Ohio R. R. Co.'s, that it will hardly be repeated this season. The foothold that Provincial and Newcastle coal secured last year seems likely to be maintained the coming year; steamers from the Provinces have arrived at New York regularly each week during the winter—a feature in that trade hitherto unknown. The receipts of Cannelton cannel at New York average about 2,500 tons per month—no recent arrival of English. The question of freights is perhaps the keystone of the whole question of cost of coal, and in this connection the following testimony by Mr. Thurber, before a committee of the New York Legislature, may be of interest; of course there is a difference between *cost* of carrying coal and what a transportation company can *afford* to carry it for.

Mr. Thurber said as follows: "I have made the coal trade a study ever since I have been in business, and especially during the past five years; my firm buys about five hundred tons of coal per year; I have made inquiry as to the cost of transporting coal; the companies claim that it costs from three-quarters of a cent to one cent and a quarter a ton per mile; in my opinion the cost is much less; the annual reports of the Philadelphia and Erie Railroad show that it costs 5 4-100 mills, while the average charge is 7 76-100 mills; on the Pennsylvania Railroad the average cost is 5 82-100 mills per mile, while the average charge is 8 92-100 mills; on the Lake Shore and Michigan Railroad the average cost is 5 61-100 mills, while the average charge is 8 17-100 mills; Colonel Fink, who is thoroughly informed upon all freight questions, is on record as saying that on a freight road with a full traffic, freight can be carried at a cost of 3 mills per ton per mile; a company carrying large quantities of coal can, of course, carry cheaper than one carrying less; freight can be carried now cheaper than it was once thought possible."

At the present time in the absence of freight arrangements for some of the domestic gas coals, we limit our quotations to the following, viz.:

Westmoreland, Penn	$5.50
Provincial	4.40
Newcastle	4.00
Cannelton's cannel	10.00

All for delivery at New York.

Gas Stocks.

Quotations by G. W. Close Jr., Broker and Dealer in Gas Stocks.

(with W. B. Scott & Co.,)

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March 2, 1878.

☞ All communications will receive particular attention

Gas. Co.'s of N. Y. City.

	Capital.	*Par.*	*Bid.*	*Asked.*
Central, Westchester	466,000	50	85	90
Harlem	$1,850,000	50	90	95x
Manhattan	4,000,000	50	205	210
Metropolitan	2,500,000	100	130	133
" Scrip	$1,000,000	...	100	103
" Bonds..	500,000	1000	92½	95
Mutual	5,000,000	100	87	—
" Bonds, gold.	900.000	1000	—	105
Municipal	1,000,000	100	90	97
New York	4,000,000	100	118	120
Suburban, W'steh'str	390,000	50	—	100
Gas Co.'s of Brooklyn.				
Brooklyn	2,000,000	25	155	160
Citizens	1,200,000	20	80	85
" Scrip	220,000	1000	95	97½
Peoples	1,000,000	10	—	40
" Bonds	$ 325,000	...	—	95
" Scrip	300,000	...	75	80
Metropolitan	1,000,000	100	65	70
Nassau	1,000,000	25	—	78
" Ctfs.	700,000	1000	96	98
Williamsburgh	1,000,000	50	105	108
" Scrip		...	95	97
Union Co. E. N. Y.		25	—	50
Richmond Co., S. I.	300,000	...	80	90
Out of Town Gas Companies.				
Bath, Maine	70,000	100		
Buffalo Mutual, N. Y	750,000	100	65	70
" Bonds	200,000	1000	95	100
Baltimore, Md.	2,000,000	100	134	134
" Ctfs., gold	1,000,000		106	110
Bayonne, N. J.		100		90
Brockport, N. Y.	25,000	100	...	80
Citizens, Newark	918,000	50	100	105
" " Bds.	124,000	—	—	—
Cincinnati G & C Co				190
Derby of Conn	160,000	100	60	80
East Boston, Mass.		25	132	—
Fort Wayne, Ind.		100	...	—
Hannibal, Mo.	100,000	100	95	100
Hartford, Conn.	700,000	25	184	186
Hempstead, L. I.	25,000	100	...	—
Jersey City	386,000	20	155	165
Jamaica, L. I.	25,000	100	...	—
Jacksonville, Ill.	120,000	50	82	...
Lewistown Maine	400,000	100	70	—
Lima, Ohio,	60,000	100	—	...
Bonds	30,000		90	
Laclede, St Louis Mo.	1,200,000	100	100	110
Long Branch		20	40	50
Peoples, Jersey City		...	120	125
Peoples of Albany	650,000	100	—	27
" Bonds	350,000	1000	—	—
Peoples of Baltimore		25	—	56
" Bonds			106	—
Perth Amboy		25	—	95
Rochester, N. Y.		100	50	60
Woonsocket, R. I.	150,000	100	100	...
Halifax N. S.	400,000	40	148	150
Hamilton, Ontario	150,000	40	117½	
San Francisco Gas-Co., S. Fr'sco Cal.			93	94
St. Louis, Missouri	600,000	50	73	75
Stillwater, Minn.	50,000	50	—	26
Saugerties, N. Y.	15,000	100	95	100
Troy, Citizens	600,000	100	—	60
Toledo, Ohio			95	97

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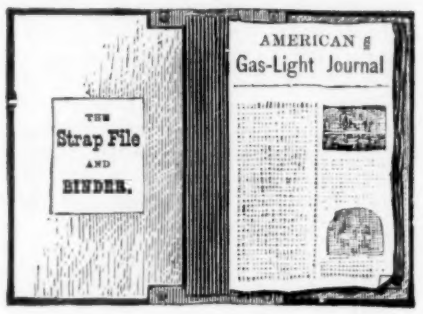

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E. S. CATHELS, ESQ.

Dear Sir: The settings of three iron retorts which I obtained from you in 1875, has more than realized our expectations, and has been so satisfactory as to leave nothing to be desired in the way of improvement on it. We have no difficulty whatever in attaining any desired heat, while the consumption of coke is very small, not half of that of our former setting. We have now been working the first setting about twelve months, and it will last some time yet. We have also adapted the same principle to a setting of two irons, with equally satisfactory results. In the summer months with our old plan, the coke produced was not sufficient for firing, and we had in addition to use coal. Last summer we saved and sold a large quantity of coke.

Yours faithfully,
(Signed) GEORGE M. FURBY, Manager and Secretary.

GAS WORKS, CHARLESTOWN, P. E. I., March 8, 1877.

E. S. CATHELS, ESQ.

Dear Sir: Yours of the 2nd inst. to hand and contents noted. In reply I beg to say that I set a bench of five retorts last summer upon your plan. They have been working up to the present time, and have given such satisfaction that I shall in future set on the same plan.

Yours truly,
(Signed) WILLIAM MURPHY, Manager.

OFFICE OF THE CINCINNATI GAS-LIGHT AND COKE COMPANY,
CINCINNATI, March 8, 1877.

E. S. CATHELS, ESQ.

Dear Sir: Yours of 2nd inst. received, and in reply state that we have one house—34 benches—of your three chambered, seven retort settings, which have given entire satisfaction.

Respectfully,
(Signed) A. A. HICKENLOOPER, V. P.

GAS WORKS, MEDINA, N. J., March 10, 1877.

MR. E. S. CATHELS.

Dear Sir: In reply to your enquiry as to the working of your setting, I have pleasure in testifying that I have not seen better or more uniform heats in an experience of twenty-five years, and there is little fuel required.

Yours truly,
(Signed) J. FINDLAY.

LISBURN GAS-LIGHT COMPANY, LIMITED,
LISBURN (IRELAND), March 20, 1877.

E. S. CATHELS, ESQ., Montreal.

Dear Sir: In reply to yours I have now four beds of six retorts set on your plan, which have given me great satisfaction, with no difficulty in obtaining good heats. My make for the last nine months has been 9,760 feet per ton of coal, and there is more coke for sale than formerly.

Yours respectfully,
(Signed) EDWARD STEARS, Manager.

GAS WORKS, APELDOORN (HOLLAND), March 28, 1877.

MR. E. S. CATHELS, MONTREAL.

Dear Sir: I am in possession of your letter of the 2nd inst., and in reply I can certify that I have been working during seven months with the oven with two retorts constructed upon your principle, and am highly satisfied with the results. The fuel account has been much less than before, and the retorts are equally and sufficiently heated.

As I don't have a station meter I cannot give the exact results of the production of gas per ton of coal, but there is no question but that the results have been far better than with any other oven employed by me.

Yours truly,
(Signed) R. BAKKER.

E. S. CATHELS, C. E.

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Having had an experience of thirty years in the Construction and Management of Gas Works, is now prepared to Construct, Alter, and Extend Works of any capacity, including all the latest Improved Apparatus, Is also Patentee of Compositions for Purifying Illuminating Gas and an improvement in Gas Retorts for Manufacturing Illuminating Gas from Naphtha.

[From the AMERICAN GAS-LIGHT JOURNAL, Oct. 2, 1877.]

"In the application and adaptation of Apparatus for the Manufacture of Illuminating Gas from Petroleum and its Products, Mr. Parham has made many experiments on a very large scale."

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Handles of SECOND GROWTH TIMBER, STEELED POINTS, and SUPERIOR EXCELLENCE. In all respects guaranteed.

Refer to all the principal Gas Companies of this country and Canada.

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HERRING & FLOYD,
Sole Agents.
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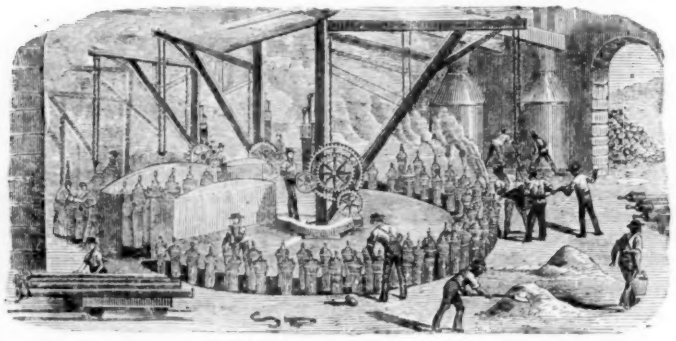
M'NEALS & ARCHER,

BURLINGTON. N. J,

Flange-Pipes



General Foundry Work.

CAST IRON PIPES

FOR WATER AND GAS.

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CastIron Gas & Water Pipes, Stop Valves, Fire Hydrants, Gas Holders. &c.

Office No. 6 North Seventh Street, Philadelphia.

ESTABLISHED 1856.

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WORKS AT PHILLIPSBURGH, N, J.
NEW YORK OFFICE, 153 BROADWAY.

Cast Iron Water and Gas Pipe

FROM TWO TO FORTY-EIGHT INCHES DIAMETER.
ALSO ALL SIZES OF

FLANGE PIPE for Sugar House and Mine Work.

Branches, Bends, Retorts, Etc., Etc. 436-1y

H. R. SMITH & CO.,

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MANUFACTURERS OF

CAST IRON GAS & WATER PIPE,

BRANCH CASTINGS, LAMP POSTS, Etc.

(Pipe from three inch and upwards cast *vertically* in 12 feet lengths.)

HEAVY AND LIGHT CASTINGS OF ALL KINDS.

DAILY CAPACITY 125 TONS.

☞ Our Works *connect direct* with *eleven railroads* centering in this city, giving us unequalled facilities for shipping to all points, at the lowest rates of freight.

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OFFICE AND WORKS—CARROLL, PIKE, SMALLMAN AND WILKINS STREETS,

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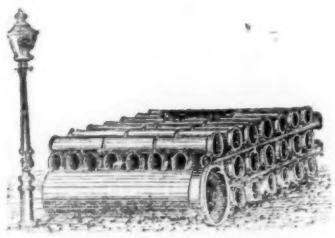

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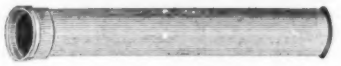
GAS, WATER, AND OIL PIPES,



Works, 18th, 19th, 20th and Railroad Street.
Office, No. 23 Nineteenth Street.

Pittsburgh, Pa.

N.B.—Pipes from 3-inch and upwards cast in 12 ft. lengths.
☞ Send for Circular and Price List.

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CAST IRON PIPES,

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All sizes from 3 to 30 inch cast vertically in 12½ feet lengths

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Foundry, Cor. of York and Moyer Streets,

PHILADELPHIA.

Several Thousand 2, 3, 4, 6 and 8 Inch Cast Iron *Gas and Water Pipes* on hand, for immediate delivery.

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Of Pittsburgh, Pa.

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YOUGHIOGHENY GAS COAL.

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Branch Office—C. & P. RR. Coal Pier,
CLEVELAND, OHIO.

WILLIAM A. McINTOSH, President.
A. CARNEGIE, Vice-President.
W. P. DE ARMIT, Treasurer.
THOMAS AXWORTHY. Agent at Cleveland, Ohio.

351-1y

THE NEWBURGH
Orrel Coal Company,

Mines at Newburg, Preston County, W. Va.
Company's Office, No. 52 S. Gay Street, Baltimore, Md.
C. OLIVER O'DONNELL, Pres't. CHAS. MACKALL, Sec'y.
CHAS. W. HAYS, Agent in New York, Room 7, Trinity Building, 111 Broadway.

This Company offer their very superior Gas Coal at lowest market prices.

It yields 10,996 cubic feet of gas to the ton of 2,240 lbs. of good illuminating power, and of remarkable purity; one bushel of lime purifying 6,792 cubic feet, with a large amount of coke of good quality.

It has been for many years very extensively used by various Gas Companies in the United States, and we beg to refer to the Manhattan, Metropolitan, and New York Gas Light Companies of New York; the Brooklyn and Citizen's Gas Light Companies of Brooklyn, N. Y.; the Baltimore Gas Light Company of Baltimore, Md., and the Providence Gas Light Company, Providence, R. I.

Best dry coals shipped from Locust Point, wharves, and prompt attention given to orders for chartering of vessels.

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THE DESPARD COAL COMPANY
OFFER THEIR SUPERIOR
DESPARD COAL

To Gas Light Companies throughout the country.
Agents, PARMELEE BROTHERS, No. 32 Pine street, N. Y.
BANGS & HORTON, No. 31 Duane street, Boston.
Mines in Harrison County, West Virginia.
Wharves Locust Point, Company's Office, 15 German St., } Baltimore.

Among the consumers of Despard Coal, we name: Manhattan Gas Light Company, New York; Metropolitan Gas Light Company, New York; Jersey City Gas Light Company, N. J.; Washington Gas Light Company; Portland Gas Light Company, Maine

*** Reference to them is requested. 204-

TYRCONNELL GAS COAL.,
MINED IN TAYLOR COUNTY, WEST VA.

Company's Office, 52 S. Gay St., Baltimore.
CHARLES MACKALL, Secretary.
CHARLES W. HAYS, Agent, Room 7, 111 B'way, N. Y.
SHIPPING POINT—Baltimore, Md.

This coal yields 10,000 cubic feet of Gas with an illuminating power of over 16 candles. Forty bushels of very superior Coke, with little Ash and scarcely any clinker 54-1y

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FORT PITT GAS COAL

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OFFICE, 337 LIBERTY STREET,
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GAS COALS.

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Their Property is located in the Youghiogheny Coal Basin, near Irwin's and Penn Station, on the Pennsylvania Railroad, and on the Youghiogheny River.

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Pennsylvania Railroad, Pier No. 2 (Lower Side).
Greenwich Wharves, Delaware River.
366-1y **Pier No. 1 (Lower Side), South Amboy, N. J.**

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OF WEST VIRGINIA.

Offer for sale the following Coals, from their Colliery at CANNELTON, Kanawha County West Virginia delivered at RICHMOND, Va.:

CANNELTON CANNEL,

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CANNELTON CAKING COAL.

MAXIMUM YIELD, **5.06** cubic feet of Gas per pound of Coal—A yield of **4·78** cubic feet per —gave **16 14-100** Candle-Power.

COKE, of very fine quality—**1453** pounds produced from one ton of coal.

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For delivery at any Port in the United States.

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CHESAPEAKE AND OHIO RAILROAD
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From the Kanawha and New River Regions, on the Line of the Chesapeake and Ohio Railroad.

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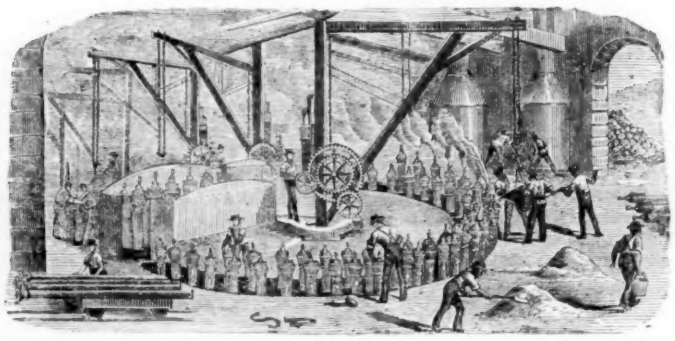
Flange-Pipes



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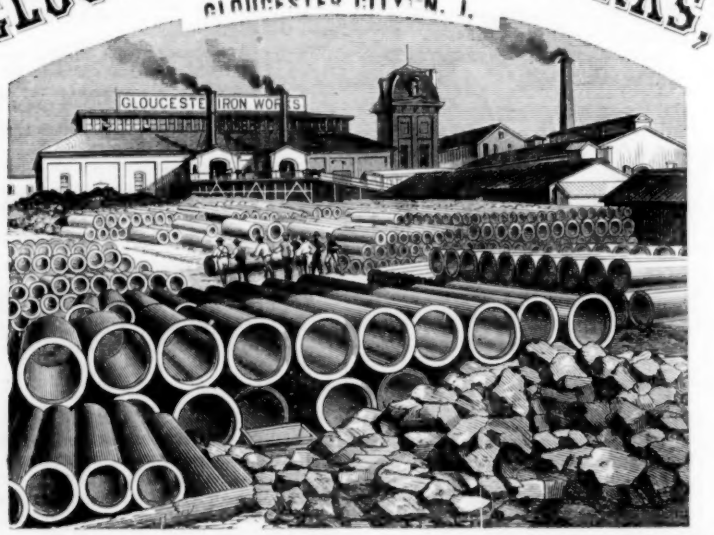

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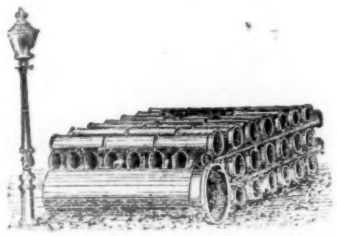

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SPLINT,
and STEAM COALS.

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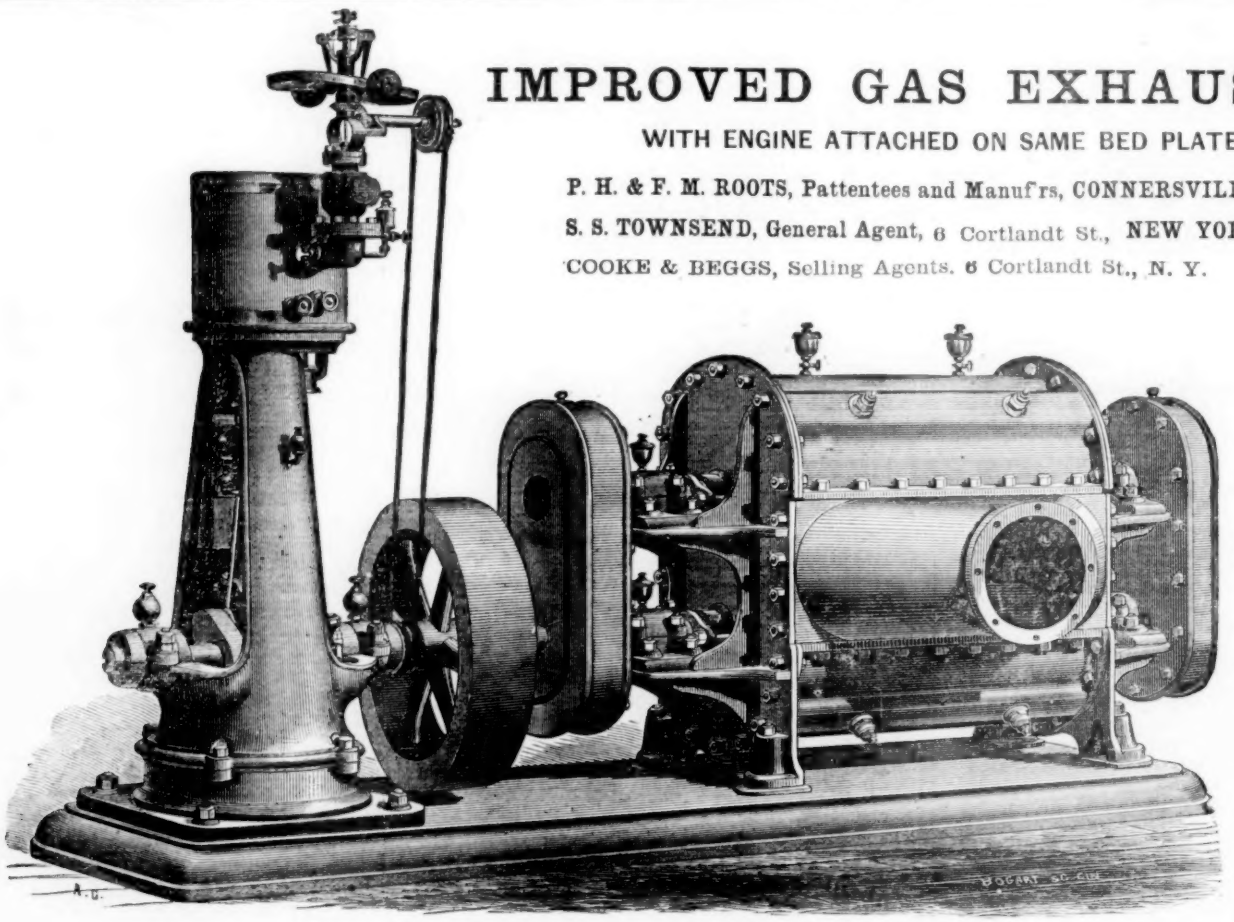

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Established 1864.

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EDWARD D. WHITE Surviving Partner of the late firm J. K. BRICK & CO.

402-1y

A. C. WOOD'S PIPE CUTTER.

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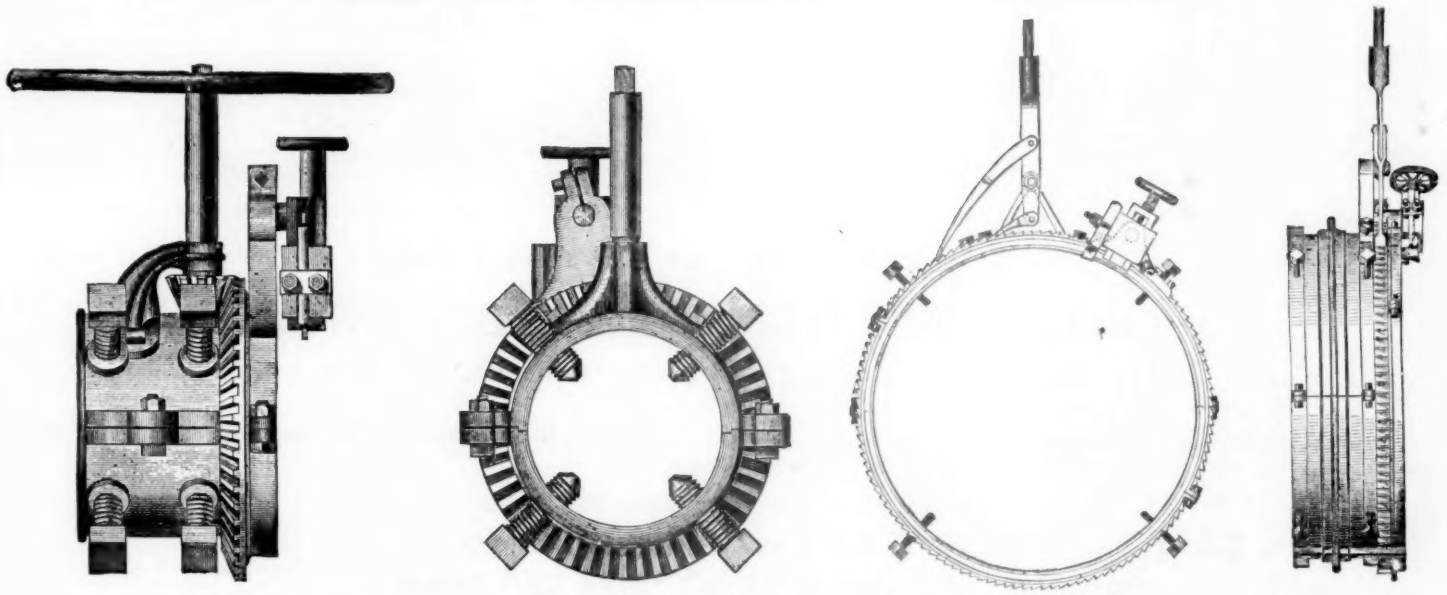
THIS IS THE ONLY HAND MACHINE IN THE WORLD FOR CUTTING

CAST IRON PIPE.



It will cut Cast or Wrought Iron Pipe, Shafts, or Columns of any size, making a clean, smooth, and square cut. Also,

A Continuous Line of Pipe in a Trench or Building.

Our Machines for cutting 30-INCH PIPE have been furnished to the Manhattan and New York Gas Light Companies, and operate to their entire satisfaction The smaller sized Machines have been in practical use for more than a year with the most satisfactory results. For further information address

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Charleston Gas-Light Co., Charleston.
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Fire Mortar, Clay and Sand.

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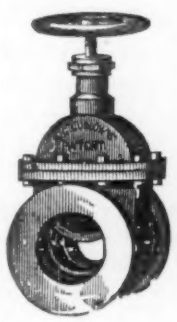

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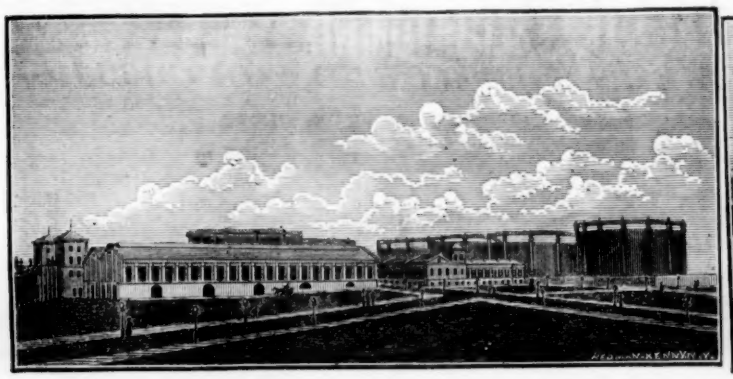

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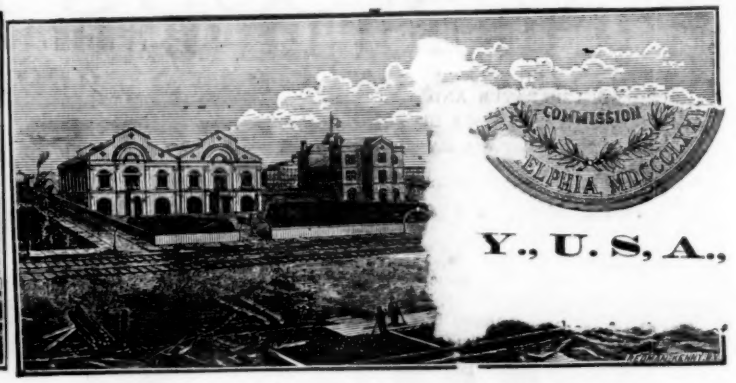

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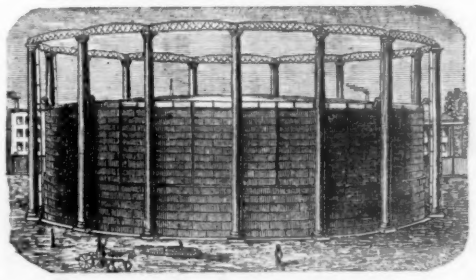

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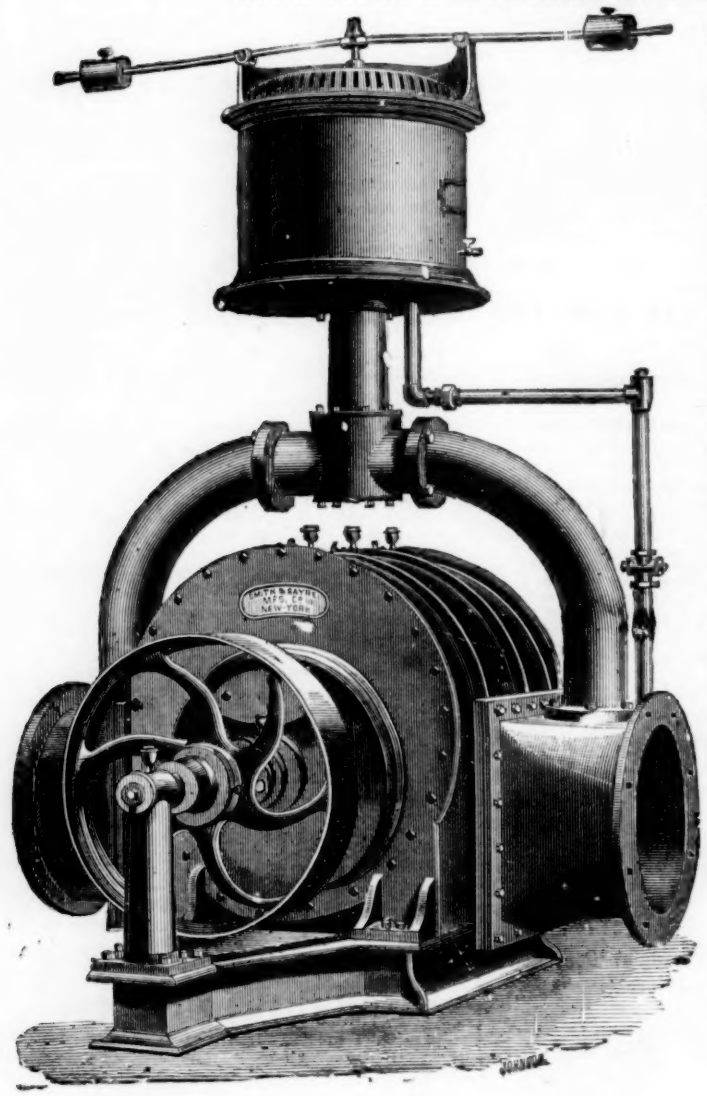

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